PB87-165403

Exploration, Development, and Production of Crude Oil and Natural Gas. (Technical Report) Field Sampling and Analytical Results

(U.S.) Environmental Protection Agency
Washington, DC

31 Jan 87

U.S. Department of Commerce
National Technical Information Service
NTIS

United States Environmental Protection Agency

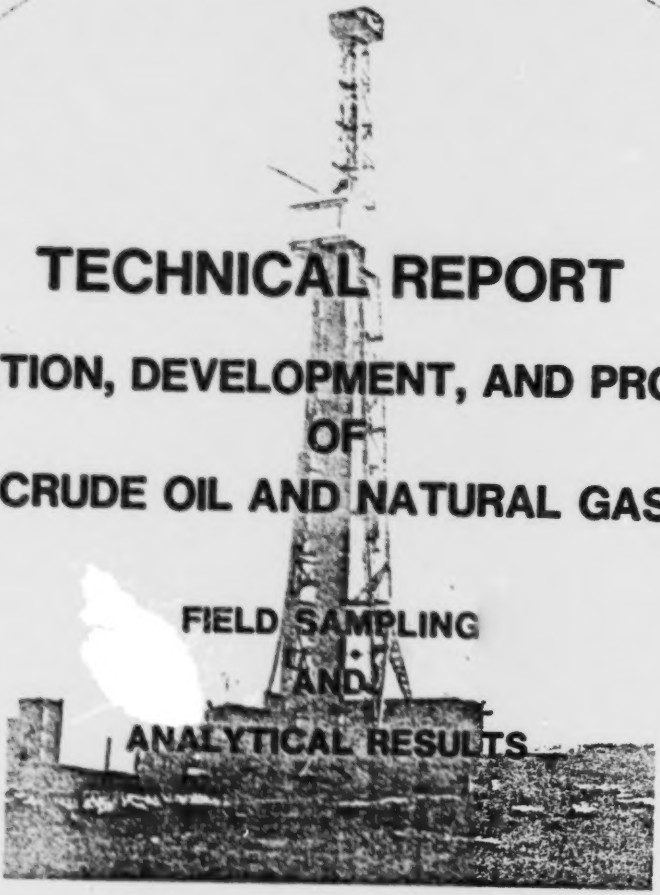
Office of Water Regulations and Standards (WH-552)
Washington, D.C. 20460

Office of Solid Waste and Emergency Response
Washington, D.C. 20460

EPA
530-SW-87-005

PB87-165403

EPA



TECHNICAL REPORT

EXPLORATION, DEVELOPMENT, AND PRODUCTION OF CRUDE OIL AND NATURAL GAS

FIELD SAMPLING
AND
ANALYTICAL RESULTS

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

50272-101

REPORT DOCUMENTATION PAGE

1. REPORT NO. 530-SW-87-005

2.

3. Recipient's Accession No. PB87-165408/AS

4. Title and Subtitle
Technical Report: Exploration, Development and Production of Crude Oil and Natural Gas; Field Sampling and Analytical Results

5. Report Date January 31, 1987

6.

7. Author(s) Bob Hall

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
U.S. EPA
Office of Solid Waste
401 M Street, S.W.
Washington, D.C. 20460

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
Bob Hall (475-7415)
Office of Solid Waste
401 M Street, S.W.
Washington, D.C. 20460

13. Type of Report & Period Covered Technical

14.

15. Supplementary Notes
This report is a support document in the overall study of the wastes produced by the Exploration, Development and Production of Crude Oil, Natural Gas and Geothermal Energy that is mandated by Section 8002(m) of RCRA.

16. Abstract (Limit: 200 words)

The U.S. Environmental Protection Agency (EPA) regulates or makes determinations as to whether to regulate the oil and gas extraction industry under several major environmental statutes. These statutes include the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act, which uses information from the study under Section 8002(m).

The purpose of this technical report is to present the findings of the field sampling and analysis project conducted on wastes associated with exploration, development, and production activities of crude oil and natural gas. This report presents the analytical methods, role and function of the Sampling Control Center, list of analytes, and the sampling plan and sampling quality assurance quality control plan.

17. Document Analysis a. Descriptors

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

18. Availability Statement

19. Security Class (This Report)

20. Security Class (This Page)

21. No. of Pages

22. Price

(See ANSI–Z39.18)

See Instructions on Reverse

OPTIONAL FORM 272 (4–77)
(Formerly NTIS–35)
Department of Commerce

TECHNICAL REPORT

EXPLORATION, DEVELOPMENT, AND PRODUCTION OF CRUDE OIL AND NATURAL GAS

FIELD SAMPLING AND ANALYSIS REPORT

U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

January 31, 1987

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EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) regulates or makes determinations as to whether to regulate the oil and gas extraction industry under several major environmental statutes. These statutes include the Clean Water Act, the Safe Drinking Water Act, and the Resource Conservation and Recovery Act. This report fulfills some of the requirements mandated by these acts.

This technical report presents the findings of the field sampling and analysis project conducted on wastes associated with exploration, development, and production activities of crude oil and natural gas (the "Project"). A summary of the analytical data is presented. Appendices to this report present the analytical results, sampling strategy, sampling reports, analytical methods, role and function of the Sample Control Center, list of analytes, and the sampling plan and sampling quality assurance/quality control plan.

The sampling program was designed to develop information about wastes from four types of sites: drill sites, production sites, centralized pits, and centralized treatment facilities. Primarily, EPA sampled drilling wastes and produced water. EPA also sampled tank bottoms and several commingled oil and gas extraction industry wastes disposed of via centralized pits or centralized treatment facilities. In total, 101 samples were collected; from this total, 42 were classified as sludges and 59 were classified as liquids. Classification of samples was determined by sampling location and/or the condition of the sample (e.g., solids content of the sample).

Nearly all samples were analyzed for 229 organic compounds, 68 metals, and 22 conventional analytes (e.g., ammonia, chloride, TSS, and BOD_5). In addition, approximately half of the sludge samples were leached using EPA's Toxicity Characteristic Leaching Procedure (TCLP). The leachate extracts from this procedure were tested for a subset of organics and metals. On selected samples, such as those collected from centralized pits and centralized treatment facilities, EPA analyzed for 136 chlorinated dioxins and furans, and 79 pesticides and herbicides.

Analytical results and quality assurance data were reported by the laboratories to EPA on magnetic tape or disk and in hard copy form. After data validation and quality assurance, all data were entered into the IBM mainframe at EPA's National Computer Center (NCC). Summary statistics were computed on both the analytical and quality assurance results.

Tables 1-3 summarize selective pollutants detected in the effluents from centralized treatment facilities, in drilling pits, and in production effluents. Pollutants selected are those which occur most frequently, have the highest concentration, or were unanticipated in samples from this industry. A complete summary of all pollutants detected, in all types of samples

Table 1. Selected Significant Pollutants Detected in Central Treatment Effluents
(For a complete listing and a description of abbreviations, see Table 15 in this report)

(Detected analytes only; weighted means)

CAS No.	Compound Name	<——Liquid Samples——> N	% Det	Mean	Units	<——Solid Samples——> N	% Det	Mean		<——TCLP Samples——> N	Det	Mean	Units
1-001	Total volatile organic carbon	3	67	4.3	mg/L	3	100	125.9	mg/kg	.	.	.	
1-002	Biochemical Oxygen Demand	3	100	3457.0	mg/L	3	100	3452.3	mg/kg	.	.	.	
1-003	Chloride	3	100	3376.7	mg/L	3	100	324890.0	mg/kg	.	.	.	
1-004	Chemical Oxygen Demand	3	100	826.7	mg/L	3	100	55936.7	mg/kg	.	.	.	
1-005	Nitrate/nitrite	3	33	20.0	mg/L	3	33	27.3	mg/kg	.	.	.	
1-006	Hydrogen ion	3	100	8.2	pH	3	100	8.3	pH	.	.	.	
1-007	Oil and grease	3	100	17.0	mg/L	3	100	20083.3	mg/kg	.	.	.	
1-008	Residue, total	.	.	.		3	100	50.1	%	.	.	.	
1-009	Residue, non-filterable	3	100	169.0	mg/L	.	.	.		.	.	.	
1-010	Residue, filterable	3	100	37793.3	mg/L	.	.	.		.	.	.	
1-011	Specific conductivity	3	100	588266.7	umho/c	.	.	.		.	.	.	
1-012	Total organic carbon	3	100	193.3	mg/L	3	100	68200.0	mg/kg	.	.	.	
1-016	Oil and Grease (Retort)	.	.	.		3	100	15603.3	mg/kg	.	.	.	
65850	Benzoic acid	3	33	1878.7	ug/L	3	0	0.0	ug/kg	2	0	0.0	ug/L
71432	Benzene	3	67	926.4	ug/L	3	33	974.6	ug/kg	3	33	34.0	ug/L
71556	1,1,1-Trichloroethane	3	33	5.9	ug/L	3	0	0.0	ug/kg	3	33	4.6	ug/L
78933	2-Butanone	3	100	136.6	ug/L	3	0	0.0	ug/kg	3	0	0.0	ug/L
85018	Phenanthrene	3	0	0.0	ug/L	3	33	4.8	ug/kg	3	0	0.0	ug/L
91203	Naphthalene	3	33	57.7	ug/L	3	33	243.8	ug/kg	3	33	8.7	ug/L
91576	2-Methylnaphthalene	3	0	0.0	ug/L	3	33	8.4	ug/kg	3	67	12.6	ug/L
92524	Biphenyl	3	0	0.0	ug/L	3	33	2729.2	ug/kg	3	0	0.0	ug/L
95487	o-Cresol	3	67	82.2	ug/L	3	0	0.0	ug/kg	3	0	0.0	ug/L
99876	p-Cymene	3	0	0.0	ug/L	3	33	13038.8	ug/kg	3	33	5.1	ug/L
100414	Ethylbenzene	3	33	45.1	ug/L	3	33	5.9	ug/kg	3	33	4.2	ug/L
100425	Styrene	3	0	0.0	ug/L	3	33	2775.2	ug/kg	3	0	0.0	ug/L
105679	2,4-Dimethylphenol	3	67	132.5	ug/L	3	0	0.0	ug/kg	3	0	0.0	ug/L
106445	p-Cresol	3	100	122.1	ug/L	3	0	0.0	ug/kg	2	0	0.0	ug/L
108101	4-Methyl-2-pentanone	3	33	23.0	ug/L	3	33	5.6	ug/kg	3	33	7.8	ug/L
108883	Toluene	3	67	426.7	ug/L	3	33	2936.5	ug/kg	3	33	109.8	ug/L
108952	Phenol	3	100	1172.1	ug/L	3	0	0.0	ug/kg	3	0	0.0	ug/L
112403	n-Dodecane	3	67	81.1	ug/L	3	67	263026.7	ug/kg	3	0	0.0	ug/L
117817	bis(2-Ethylhexyl) phthalate	3	67	41.7	ug/L	3	33	1668.4	ug/kg	3	67	52.8	ug/L
142621	hexanoic acid	3	33	175.3	ug/L	3	0	0.0	ug/kg	2	0	0.0	ug/L
593453	n-Octadecane	3	67	48.8	ug/L	3	100	132105.8	ug/kg	3	0	0.0	ug/L
629594	n-Tetradecane	3	67	66.3	ug/L	3	67	177661.5	ug/kg	3	0	0.0	ug/L
630013	n-Hexacosane	3	0	0.0	ug/L	3	100	122851.6	ug/kg	3	0	0.0	ug/L
832699	1-Methylphenanthrene	3	0	0.0	ug/L	3	33	13.9	ug/kg	3	0	0.0	ug/L
1746016	2,3,7,8-TCDD (Dioxin)	.	.	.		4	33	3.4	ng/kg	.	.	.	
7439896	Iron	3	67	183.7	ug/L	3	100	16430.0	mg/kg	3	33	616.7	ug/L
7439954	Magnesium	3	100	90016.7	ug/L	3	100	68173.3	mg/kg	3	100	387936.7	ug/L
7439965	Manganese	3	67	662.7	ug/L	3	100	605.3	mg/kg	3	67	1753.3	ug/L
7440213	Silicon	3	67	2013.3	ug/L	3	100	964.7	mg/kg	3	100	1879.0	ug/L
7440246	Strontium	3	100	70826.7	ug/L	3	100	656.3	mg/kg	3	100	4910.0	ug/L
7440315	Tin	3	67	589.7	ug/L	3	100	36.0	mg/kg	3	33	92.0	ug/L
7440393	Barium	3	100	6556.7	ug/L	3	100	11933.3	mg/kg	3	100	2454.0	ug/L
7440428	Boron	3	100	3676.7	ug/L	3	67	96.7	mg/kg	3	67	765.3	ug/L
7440666	Zinc	3	100	190.0	ug/L	3	100	815.3	mg/kg	3	67	1136.7	ug/L
7440702	Calcium	3	100	3599333	ug/L	3	100	56833.3	mg/kg	3	100	661666.7	ug/L
7664417	Ammonia	3	100	35.5	mg/L	3	100	48.7	mg/kg	.	.	.	
7704349	Sulfur	3	100	154500.0	ug/L	3	67	1643.3	mg/kg	3	100	20550.0	ug/L
7723140	Phosphorus	3	33	680.0	ug/L	3	67	487.7	mg/kg	3	33	166.7	ug/L
16984488	Fluoride	3	100	1.6	mg/L	3	100	293.7	mg/kg	.	.	.	

Table 2. Selected Significant Pollutants Detected in Drilling Pits
(For a complete listing and a description of abbreviations, see Table 15 in this report)

(Detected analytes only; weighted means)

		<——Liquid Samples——>				<——Solid Samples——>				<——TCLP Samples——>			
CAS No.	Compound Name	N	% Det	Mean	Units	N	% Det	Mean		N	Det	Mean	Units
1-002	Biochemical Oxygen Demand	17	100	493.3	mg/L	20	100	2852.3	mg/kg	.	.	.	
1-003	Chloride	17	100	6686.8	mg/L	20	100	38976.3	mg/kg	.	.	.	
1-004	Chemical Oxygen Demand	17	100	5086.3	mg/L	20	100	110457.6	mg/kg	.	.	.	
1-005	Nitrate/nitrite	17	98	5.8	mg/L	20	96	76.9	mg/kg	.	.	.	
1-006	Hydrogen ion	17	100	7.7	pH	20	100	9.1	pH	.	.	.	
1-007	Oil and grease	17	100	482.2	mg/L	20	100	32742.1	mg/kg	.	.	.	
1-008	Residue, total	1	100	41.0	%	21	100	32.9	%	.	.	.	
1-009	Residue, non-filterable	16	100	18386.0	mg/L	.	.	.		.	.	.	
1-010	Residue, filterable	16	100	38241.8	mg/L	.	.	.		.	.	.	
1-011	Specific conductivity	17	100	88146.9	umho/c	.	.	.		.	.	.	
1-012	Total organic carbon	17	100	450.0	mg/L	20	100	34336.6	mg/kg	.	.	.	
1-016	Oil and Grease (Retort)	.	.	.		20	100	24134.3	mg/kg	.	.	.	
58902	2,3,4,6-Tetrachlorophenol	15	6	72.1	ug/L	19	0	0.0	ug/kg	15	0	0.0	ug/L
65850	Benzoic acid	15	7	12.2	ug/L	19	1	0.2	ug/kg	15	10	11.1	ug/L
71432	Benzene	16	6	0.9	ug/L	18	73	96.0	ug/kg	18	0	0.0	ug/L
75150	Carbon disulfide	16	1	0.2	ug/L	18	57	11.8	ug/kg	18	0	0.0	ug/L
78933	2-Butanone	16	8	7.3	ug/L	18	84	14300.6	ug/kg	18	0	0.0	ug/L
85018	Phenanthrene	15	51	208.1	ug/L	19	1	14.0	ug/kg	18	0	0.0	ug/L
87865	Pentachlorophenol	15	6	3826.4	ug/L	19	2	5112.6	ug/kg	15	6	990.7	ug/L
91203	Naphthalene	15	51	43.9	ug/L	19	16	47123.6	ug/kg	18	15	218.0	ug/L
91576	2-Methylnaphthalene	15	52	80.9	ug/L	19	66	12.1	ug/kg	18	77	40.0	ug/L
99876	p-Cymene	15	51	16.4	ug/L	19	11	13853.0	ug/kg	18	0	0.0	ug/L
100414	Ethylbenzene	16	1	0.1	ug/L	18	72	1450.8	ug/kg	18	15	2.6	ug/L
108101	4-Methyl-2-pentanone	15	56	26.3	ug/L	19	3	0.9	ug/kg	18	86	17.4	ug/L
108883	Toluene	16	78	186.6	ug/L	18	85	1209.9	ug/kg	18	76	12.8	ug/L
108952	Phenol	15	7	3.9	ug/L	19	1	45.4	ug/kg	18	1	1.3	ug/L
112958	n-Eicosane	15	59	4094.3	ug/L	19	93	154434.4	ug/kg	18	0	0.0	ug/L
117817	bis(2-Ethylhexyl) phthalate	15	11	2.1	ug/L	19	82	3440.4	ug/kg	18	22	5.4	ug/L
124185	n-Decane	15	52	764.3	ug/L	19	63	1645.2	ug/kg	18	4	21.7	ug/L
142621	hexanoic acid	15	16	8.8	ug/L	19	0	0.0	ug/kg	15	38	31.8	ug/L
544763	n-Hexadecane	15	83	4733.3	ug/L	19	93	593974.6	ug/kg	18	0	0.0	ug/L
615225	2-(methylthio)benzothiazole	15	0	0.1	ug/L	19	0	0.0	ug/kg	18	0	0.1	ug/L
1746016	2,3,7,8-TCDD (Dioxin)	.	.	.		4	89	9.3	ng/kg	.	.	.	
7429905	Aluminum	17	100	202058.6	ug/L	21	100	9682.9	mg/kg	21	82	1670.9	ug/L
7439896	Iron	17	100	366030.3	ug/L	21	100	23576.8	mg/kg	21	99	7111.2	ug/L
7439921	Lead	17	36	693.7	ug/L	21	44	79.5	mg/kg	21	81	582.0	ug/L
7439954	Magnesium	17	100	178942.8	ug/L	21	100	6538.4	mg/kg	21	100	24877.0	ug/L
7439965	Manganese	17	100	5228.3	ug/L	21	100	446.7	mg/kg	21	100	2751.6	ug/L
7440097	Potassium	17	100	2280010	ug/L	21	17	3047.0	mg/kg	21	17	17023.4	ug/L
7440213	Silicon	17	97	69350.8	ug/L	21	43	1729.4	mg/kg	21	41	25836.9	ug/L
7440246	Strontium	17	100	24300.5	ug/L	21	44	155.7	mg/kg	21	44	3695.6	ug/L
7440326	Titanium	17	87	550.7	ug/L	21	100	143.9	mg/kg	21	7	4.1	ug/L
7440393	Barium	17	100	42414.3	ug/L	21	100	8921.1	mg/kg	21	100	1494.1	ug/L
7440428	Boron	17	100	16929.5	ug/L	21	70	75.2	mg/kg	21	82	716.2	ug/L
7440473	Chromium	17	41	1355.9	ug/L	21	93	33.8	mg/kg	21	58	76.7	ug/L
7440508	Copper	17	40	363.7	ug/L	21	99	35.1	mg/kg	21	65	51.0	ug/L
7440666	Zinc	17	100	1539.9	ug/L	21	100	139.4	mg/kg	21	100	5782.9	ug/L
7440702	Calcium	17	100	1059199	ug/L	21	100	40147.4	mg/kg	20	100	1133900	ug/L
7704349	Sulfur	17	98	230393.5	ug/L	21	100	6970.4	mg/kg	21	100	34414.6	ug/L
7723140	Phosphorus	17	100	5682.9	ug/L	21	22	84.5	mg/kg	21	1	2.7	ug/L
16984488	Fluoride	17	100	10.2	mg/L	20	100	475.6	mg/kg	.	.	.	
18496258	Sulfide	17	17	0.0	mg/L	20	44	703.9	mg/kg	.	.	.	

Table 3. Selected Significant Pollutants Detected in Production Endpoints
(For a complete listing and a description of abbreviations, see Table 15 in this report)

(Detected analytes only; weighted means)

CAS No.	Compound Name	<——Liquid Samples——> N	% Det	Mean	Units	<——Solid Samples——> N	% Det	Mean	<——TCLP Samples——> N	Det	Mean	Units
1-001	Total volatile organic carbon	21	100	0.7	mg/L	.	.	.	.	.	.	
1-002	Biochemical Oxygen Demand	21	100	162.1	mg/L	.	.	.	.	.	.	
1-003	Chloride	21	100	9643.0	mg/L	.	.	.	.	.	.	
1-004	Chemical Oxygen Demand	21	100	1583.2	mg/L	.	.	.	.	.	.	
1-007	Oil and grease	21	100	50.9	mg/L	.	.	.	.	.	.	
1-009	Residue, non-filterable	21	100	89.3	mg/L	.	.	.	.	.	.	
1-010	Residue, filterable	21	100	21414.0	mg/L	.	.	.	.	.	.	
1-011	Specific conductivity	21	100	47573.1	umho/c	.	.	.	.	.	.	
1-012	Total organic carbon	21	100	56.3	mg/L	.	.	.	.	.	.	
1-017	Salinity (from chloride)	16	100	16665.8	mg/L	.	.	.	.	.	.	
65850	Benzoic acid	21	1	12.9	ug/L	.	.	.	.	.	.	
71432	Benzene	21	92	447.4	ug/L	.	.	.	.	.	.	
78933	2-Butanone	21	1	9.2	ug/L	.	.	.	.	.	.	
85018	Phenanthrene	21	8	12.2	ug/L	.	.	.	.	.	.	
91203	Naphthalene	21	85	65.1	ug/L	.	.	.	.	.	.	
91576	2-Methylnaphthalene	21	84	29.1	ug/L	.	.	.	.	.	.	
92524	Biphenyl	21	9	3.2	ug/L	.	.	.	.	.	.	
95487	o-Cresol	21	41	24.0	ug/L	.	.	.	.	.	.	
99876	p-Cymene	21	8	16.8	ug/L	.	.	.	.	.	.	
100414	Ethylbenzene	21	7	9.6	ug/L	.	.	.	.	.	.	
105679	2,4-Dimethylphenol	21	46	110.0	ug/L	.	.	.	.	.	.	
106445	p-Cresol	21	41	62.2	ug/L	.	.	.	.	.	.	
108101	4-Methyl-2-pentanone	21	98	57.3	ug/L	.	.	.	.	.	.	
108883	Toluene	21	92	232.3	ug/L	.	.	.	.	.	.	
108952	Phenol	21	62	71.4	ug/L	.	.	.	.	.	.	
112403	n-Dodecane	21	60	983.5	ug/L	.	.	.	.	.	.	
117817	bis(2-Ethylhexyl) phthalate	21	98	133.3	ug/L	.	.	.	.	.	.	
124185	n-Decane	21	53	2794.8	ug/L	.	.	.	.	.	.	
132650	Dibenzothiophene	21	52	15.2	ug/L	.	.	.	.	.	.	
142621	Hexanoic acid	21	2	12.4	ug/L	.	.	.	.	.	.	
544763	n-Hexadecane	21	53	662.0	ug/L	.	.	.	.	.	.	
615225	2-(methylthio)benzothiazole	21	40	12.9	ug/L	.	.	.	.	.	.	
629594	n-Tetradecane	21	53	775.9	ug/L	.	.	.	.	.	.	
832699	1-Methylphenanthrene	21	8	24.7	ug/L	.	.	.	.	.	.	
7439896	Iron	24	93	2372.0	ug/L	.	.	.	.	.	.	
7439932	Lithium	24	64	2670.3	ug/L	.	.	.	.	.	.	
7439954	Magnesium	24	100	112673.0	ug/L	.	.	.	.	.	.	
7439965	Manganese	24	96	236.6	ug/L	.	.	.	.	.	.	
7440097	Potassium	24	69	67830.7	ug/L	.	.	.	.	.	.	
7440213	Silicon	24	99	23499.2	ug/L	.	.	.	.	.	.	
7440235	Sodium	24	100	4150657	ug/L	.	.	.	.	.	.	
7440246	Strontium	24	100	18291.9	ug/L	.	.	.	.	.	.	
7440315	Tin	24	83	211.0	ug/L	.	.	.	.	.	.	
7440382	Arsenic	24	69	268.3	ug/L	.	.	.	.	.	.	
7440393	Barium	24	93	17455.1	ug/L	.	.	.	.	.	.	
7440428	Boron	24	100	11881.8	ug/L	.	.	.	.	.	.	
7440666	Zinc	24	100	53.7	ug/L	.	.	.	.	.	.	
7440702	Calcium	24	100	515234.4	ug/L	.	.	.	.	.	.	
7704349	Sulfur	24	99	373592.6	ug/L	.	.	.	.	.	.	
7723140	Phosphorus	24	1	15.8	ug/L	.	.	.	.	.	.	
16984488	Fluoride	21	100	1.9	mg/L	.	.	.	.	.	.	
18496258	Sulfide	21	11	13.9	mg/L	.	.	.	.	.	.	

analyzed, is given in the RESULTS AND CONCLUSIONS section of this report.

The data have been weighted by production volumes and, therefore, represent EPA's best estimate of average, nationwide pollutant concentrations in this industry. These data show that the highest frequencies of occurrences and highest average concentrations are for pollutants normally associated with oil and gas exploration, based on the technical literature and other EPA studies.

The Agency is now in the process of evaluating and interpreting the analytical data; therefore, this report draws no conclusions or inferences from the data compiled at this point. Interpretations and findings derived from the data will be contained in future reports that will be available for public comment.

Additional field sampling data may be collected by the Agency in the future if EPA determines that more field work is appropriate and necessary. EPA is expecting to receive similar analytical data from the American Petroleum Institute's (API's) concurrent field sampling program. The API data, along with any other data submitted to the Agency, will be evaluated by the Agency to determine appropriateness for inclusion in the Report to Congress. If the Agency decides to include such data, they will be available for public comment when the Report is published.

INTRODUCTION

Overview

The U.S. Environmental Protection Agency (EPA) regulates or makes determinations as to whether to regulate the oil and gas extraction industry under several major environmental statutes. These statutes include the Clean Water Act (i.e., appropriate effluent limitations guidelines), the Safe Drinking Water Act (i.e., the underground injection control program), and the Resource Conservation and Recovery Act (i.e., the regulatory determination under RCRA Section 3001(b)(2)(B), which uses information from the study under Section 8002(m)).

The purpose of this technical report is to present the findings of the field sampling and analysis project conducted on wastes associated with exploration, development, and production activities of crude oil and natural gas. This report presents the analytical results, sampling strategy, sampling reports, analytical methods, role and function of the Sample Control Center, list of analytes, and the sampling plan and sampling quality assurance quality control plan.

This report is a summary document that gives an overview of the project and summarizes the analytical results and the quality control/quality assurance results. It is supported by seven appendices. Two of these appendices give detailed listings of the analytes tested for and the analytical results; the remaining

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appendices give the Sampling Strategy, the Sampling Plan and Sampling Quality Assurance/Quality Control Plan, the Sampling Reports, the Analytical Methods, and the role and function of the EPA Sample Control Center.

The completion of this technical report fulfills an obligation in the settlement agreement of Alaska Center for the Environment et al. v. EPA [Civil Action No. A89-471 (D. Alaska)].

Regulatory Background

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA) establishes a comprehensive scheme regulating the management of solid wastes. Some solid wastes are classified as hazardous under RCRA Subtitle C and are therefore subject to more stringent requirements than other solid wastes, i.e., regulations governing generation, transportation, treatment, storage, and disposal.

However, the 1980 amendments to RCRA excluded several types of solid wastes from regulation as hazardous wastes until EPA has submitted certain studies to Congress and made certain regulatory determinations [Solid Waste Disposal Act Amendments of 1980, Pub. L. No. 94-482, Section 29, 94 Stat. 2349]. One set of waste sources subject to this exclusion is "drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil or natural gas or geothermal energy" [RCRA Section 3001(b)(2)(A)].

Under the 1980 amendments, even if these solid wastes would otherwise be considered hazardous wastes under RCRA (either "listed" or having hazardous waste characteristics), they cannot be regulated as hazardous wastes until EPA has completed the studies required under RCRA Section 8002(m), issued the requisite Report to Congress, conducted public hearings, made recommendations to promulgate standards to Congress, and promulgated such regulations which only take effect after authorization by Congress.

Pursuant to Section 3001(a) and Section 3001(b) of the RCRA regulations, solid wastes can be classified as hazardous in two ways. First, EPA can determine that a particular type or category of solid wastes is hazardous and should be included on a list of categorically hazardous wastes [40 CFR Section 261.11, 261.30-261.33 (1984)]; the lists under 261.33 were updated in 1986 [52 FR 28296]. Second, if a solid waste exhibits one of four characteristics (ignitability, corrosivity, reactivity, or extraction-procedure toxicity), it is considered hazardous [40 CFR Section 261.10, 261.20 to 261.24 (1984)].

Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Section 101(a) of the Act declares that it is a national goal to eliminate "the discharges of pollutants into the navigable waters." By July 1, 1977, existing industrial dischargers were required to achieve "effluent limitations requiring the application of the best practicable control technology currently available" (BPTCA), as specified in Section 301(b)(1)(A). By July 1, 1983, these dischargers were required to achieve "effluent limitations requiring the application of the best available technology economically achievable (BAT), which will result in reasonable further progress toward the national goal of eliminating the discharge of pollutants," as specified in Section 301(b)(2)(A). New industrial direct dischargers were required to comply with new source performance standards (NSPS), as specified in Section 306, based on best available demonstrated technology. New and existing dischargers to publicly owned treatment works (POTWs) were subject to pretreatment standards under Sections 307(b) and Section 307(c). While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTWs (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis in the absence of regulations, Congress intended that, for the most part, control requirements would be based on regulations promulgated by the Administrator of EPA.

Section 304(b) of the Act required the Administrator to promulgate regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of BPT and BAT. Moreover, Sections 304(c) and 306 of the Act required promulgation of New Source Performance Standards (NSPS). Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to these regulations for designated industry categories, Section 307(a) of the Act required the Administrator to promulgate effluent standards applicable to all dischargers of toxic pollutants. Finally, Section 501(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

On December 27, 1977, the President signed into law the Clean Water Act of 1977. Although this law makes several important changes in the Federal water pollution control program, its most significant feature is its incorporation into the Act a program for toxic pollution control. Section 301(b)(2)(A) and Section 301(b)(2)(C) of the Act required the achievement by July 1, 1984, of effluent limitations requiring application of BAT for "toxic" pollutants, including the 65 "priority" pollutants and classes of pollutants which Congress declared "toxic" under Section 307(a) of the Act. Likewise, EPA's programs for New Source Performance Standards and pretreatment standards are now aimed principally at toxic pollutant controls. Moreover, to strengthen the toxics control program, Congress added Section

304(e) to the Act. Section 304(e) authorizes the Administrator to prescribe what have been termed "best management practices" (BMPs) to prevent the release of toxic pollutants from plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage associated with, or ancillary to, the manufacturing or treatment process.

The Clean Water Act of 1977 also revised the control program for nontoxic pollutants. Section 301(b)(2)(E) now requires achievement by July 1, 1984 of "effluent limitations requiring the application of the best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those mentioned specifically in Section 304(a)(4), (biochemical oxygen-demanding pollutants (BOD_5), total suspended solids (TSS), fecal coliform, and pH), plus any additional pollutants defined by the Administrator as "conventional." On July 30, 1979, the Agency designated oil and grease as a conventional pollutant (44 FR 44501).

For nontoxic, nonconventional pollutants, Sections 301(b)(2)(A) and (F) require achievement of BAT effluent limitations within three years after their establishment or July 1, 1984, whichever is later, but not later than July 1, 1987. On April 13, 1979, BPT effluent limitations guidelines were promulgated for the onshore subcategory, coastal subcategory, and the agricultural and wildlife water use subcategory of the oil and gas extraction industry [44 FR 22069]. Effluent limitations were reserved for the stripper subcategory due to lack of technical data.

The 1979 BPT regulation established a zero discharge limitation for all wastes under the onshore subcategory. The limits for the coastal subcategory established oil and grease and residual chlorine limitations equivalent to the offshore subcategory. Zero discharge agricultural and wildlife subcategory limitations were established, except for produced water which has a 35 mg/L oil and grease limitation.

The American Petroleum Institute (API) challenged the 1979 regulation [API v. EPA, 661 F.2d 340 (5th Cir. 1981)]. The Court remanded EPA's decision transferring 1,700 wells from the coastal to the onshore subcategory (47 FR 31554). The Court also directed EPA to consider establishing discharge limits for marginal gas wells.

Project Objectives

The objectives of this Project were to identify and quantify waste constituents, to document site-specific waste sources and volumes, and to aid in documentation of nationwide and specific regional industry practices. These objectives were met by collecting technical data through the literature and industry sources and by collecting and analyzing samples of waste.

Specific objectives of the oil and gas exploration, development, and production Field Sampling and Analysis Project included:

- Provide data to be included in the report to Congress on wastes associated with oil and gas exploration, development, and production activities as required by RCRA.
- Provide nationwide data on sources and volumes of oil and gas wastes.
- Provide information on the complexity and diversity of the wastes generated by the industry, current disposal practices, and ultimate treatment.
- Identify characteristics and constituents of the waste streams and estimate variability of these waste streams.
- Provide data that can be used in the design of a larger, more comprehensive sample survey of the industry.

PROJECT DESCRIPTION

Project Management

This report presents results from a sampling and analysis project managed by EPA's Industrial Technology Division (ITD) using contractors to perform the sampling, analysis, data review, and statistical analysis. Figure 1 illustrates the relationships among the EPA offices and contractors involved in this project. Overall sampling, analysis, and data collection activities were coordinated by the EPA Sample Control Center. ITD has used these systems for more than eight years to support effluent limitations and guidelines development.

This Project also parallels the Project conducted by ITD in 1981 to characterize the offshore oil and gas industry, although the diversity of sites and types of chemical testing performed were greater in this Project than in the Offshore Project.

Sampling Strategy

Overview

This section summarizes the sampling strategy and its implementation in this Project. A draft document describing the Agency's sampling strategy was published in May of 1986. The draft document has been revised to reflect actual implementation of the sampling strategy. Appendix B presents the revised sampling strategy document.

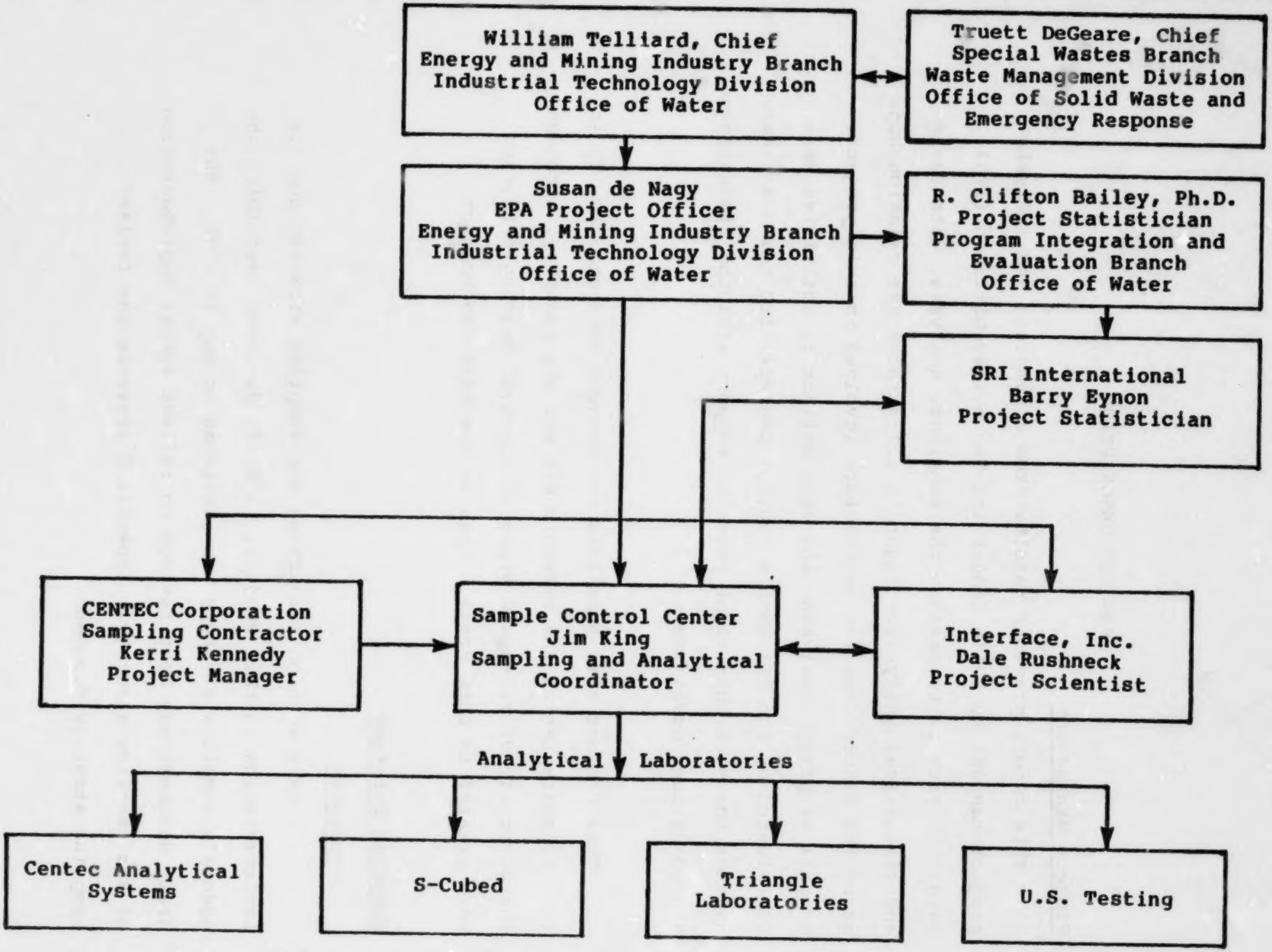

William Telliard, Chief
Energy and Mining Industry Branch
Industrial Technology Division
Office of Water
Truett DeGeare, Chief
Special Wastes Branch
Waste Management Division
Office of Solid Waste and
Emergency Response
Susan de Nagy
EPA Project Officer
Energy and Mining Industry Branch
Industrial Technology Division
Office of Water
R. Clifton Bailey, Ph.D.
Project Statistician
Program Integration and
Evaluation Branch
Office of Water
SRI International
Barry Eynon
Project Statistician
CENTEC Corporation
Sampling Contractor
Kerri Kennedy
Project Manager
Sample Control Center
Jim King
Sampling and Analytical
Coordinator
Interface, Inc.
Dale Rushneck
Project Scientist
Analytical Laboratories
Centec Analytical
Systems
S-Cubed
Triangle
Laboratories
U.S. Testing

Figure 1. Project Management Organization

Target Population

The sampling program was designed to develop information about wastes from four types of sites: drill sites, production sites, centralized pits, and centralized treatment facilities. The total number of sample sites was 49, distributed as shown in Table 4.

Eighty-six percent of the sites sampled were active drill or production sites. This allocation reflects the Agency's interest in developing information regarding the most prevalent waste sources within the industry. Fourteen percent of the sites sampled were centralized waste storage or treatment facilities. This allocation addresses the need to develop information about the types of processes, characteristics of commingled waste, and the characteristics of treated commingled wastes.

Selection of Sample Sites

A sample frame was constructed by geographically defining eleven zones (or strata). These zones were primarily developed by grouping common geological formations and operating practices, using state borders as boundaries between zones. (Refer to Appendix B for a detailed discussion of zone construction.) Figure 2 shows the zones used for site selection. Zone 1 and Zone 3 were excluded from the sample frame because there was essentially no oil and gas exploration, production, or development activity in those states. Thus, sample sites were distributed through nine zones.

Table 4. Distribution of Types of Sample Sites.

Type of site	Number of sites sampled
Drill sites	19
Production sites	
Produced water	21
Tank bottom sludges	2
Centralized pits	4
Centralized treatment	3
Total	49

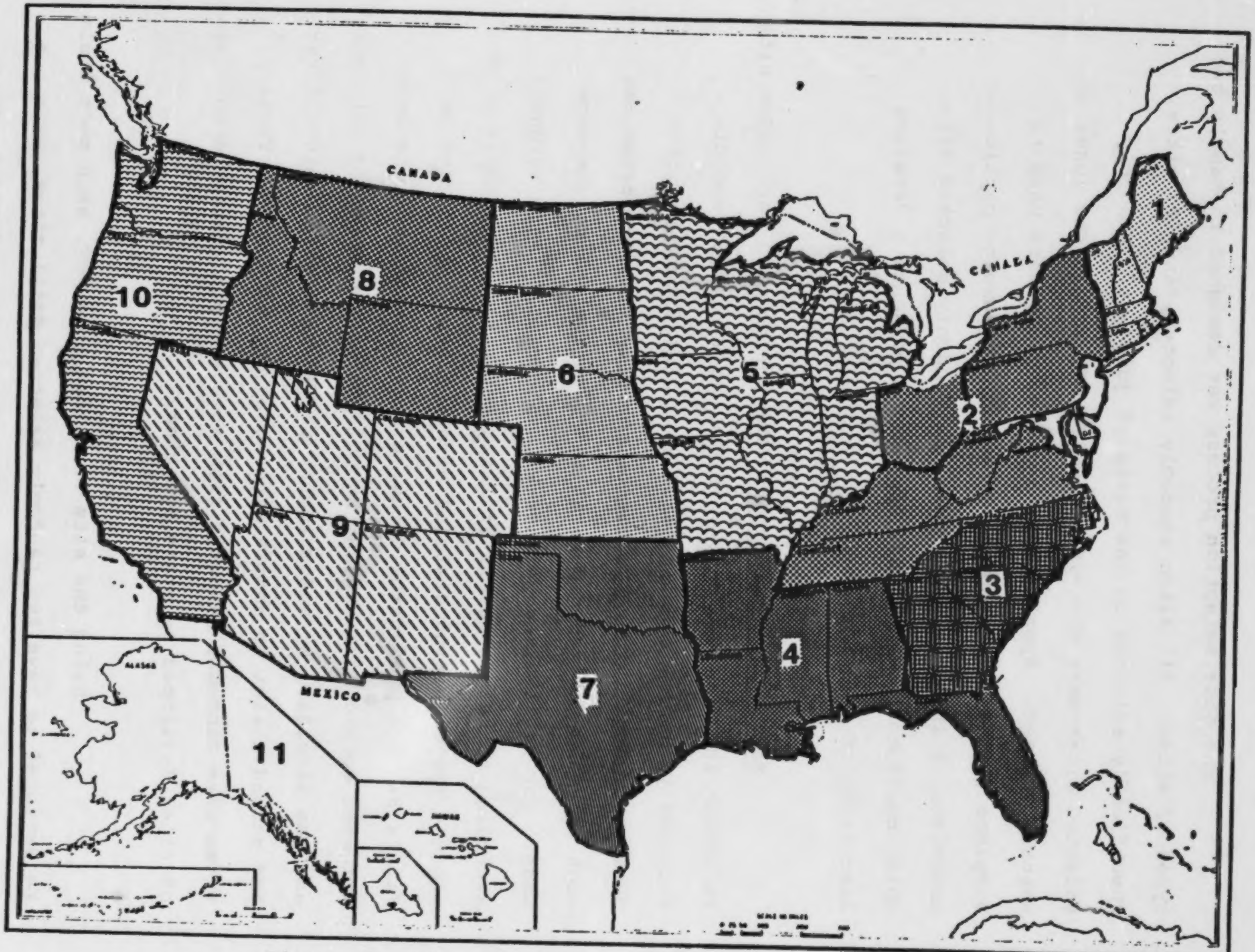

CANADA
CANADA
MEXICO
1
2
3
4
5
6
7
8
9
10
11
ALASKA

Figure 2. Site Selection Zones

The site selection process was designed to handle two types of sites: (1) sites randomly selected, and (2) sites specifically selected on the basis of judgment. Randomly selected sites were distributed uniformly across the zones to ensure coverage. Specifically selected sites were used to supplement equal distribution of sites, to examine particular practices of interest, or to replace randomly selected sites which could not be sampled. Appendix B presents a detailed discussion of this strategy.

Random site selection. The design used for random site selection involved two steps: First, states were randomly selected to become sampling site hosts based on a weighted measure of drilling or production activity that reflected the most recently published data at the time the selections were made. For drill sites, states within each zone were weighted according to recent annual drilling activity. An example of the process for selecting state(s) within zones is presented in Figure 3. For production sites, states within each zone were weighted according to recent annual production rates of oil, gas, and gas liquids. A random number table was used to select first and second states as sample site hosts for each zone. Finally, sites were randomly selected from each selected state using lists of sites developed by state agencies.

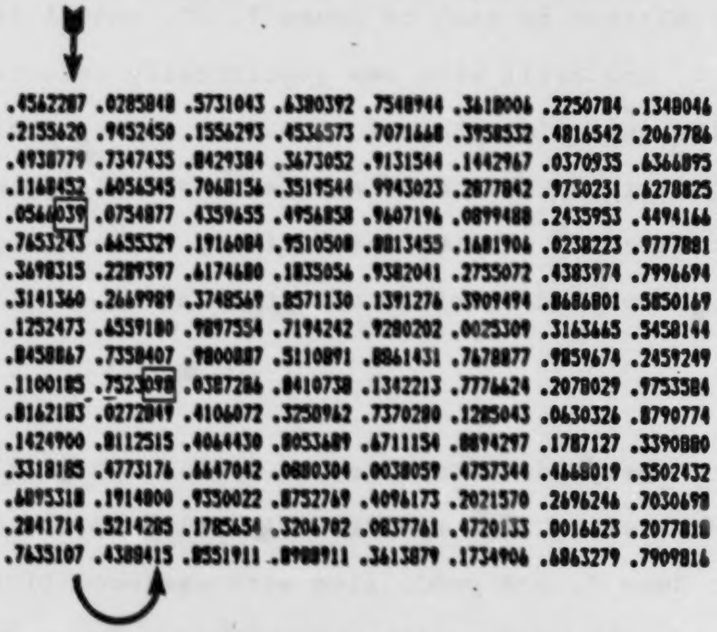
Using the site selection strategy, each zone would be expected to have two randomly selected drill sites, with one extra drill site in the zone of most activity. Table 5 shows

STEP 1: Choose a zone for selection of states within zones. In this example, Zone 7 was chosen.[1]

STEP 2: Using the most recent published reports, assign sequential integers to each state within Zone 7 (our example), in proportion to the type of activity and sample. In this example, 26 integers (sequentially 001 through 026) were assigned to Oklahoma. This assignment corresponds to Oklahoma's 26 percent of the drilling activity in Zone 7. The next 74 integers (027 through 101) were assigned to Texas (corresponding to Texas' 74 percent of the zone's drilling activity).

NOTE: For selection of production sites, integers were assigned proportional to percent of zone production.

STEP 3: Use a random number table to select the appropriate number of sites (see below). In this example, two drill sites were to be selected. As can be seen on the random table below, the first two integers encountered between 001 and 101 were 039 and 098.[2] Both integers fell between 027 and 101; thus, both sites were selected to be sampled in Texas.



.4562287	.0285848	.5731043	.6380392	.7548944	.3618006	.2250784	.1348046
.2155620	.9452450	.1556293	.4536573	.7071668	.3958532	.4816542	.2067786
.4938779	.7347435	.8429384	.3673052	.9131544	.1442967	.0370935	.6366895
.1168452	.6056545	.7068156	.3519544	.9943023	.2877842	.9730231	.6278825
.0566039	.0754877	.4359655	.4956858	.9607196	.0899488	.2435953	.4494166
.7653243	.6655329	.1916084	.9510508	.8813455	.1681906	.0238223	.9777881
.3698315	.2289397	.6174680	.1835056	.9382041	.2755072	.4383974	.7996694
.3141360	.2669989	.3748569	.8571130	.1391276	.3909494	.8686801	.5850169
.1252473	.6559180	.9897554	.7194242	.9280202	.0025309	.3163665	.5458144
.8450867	.7350407	.9800887	.5110891	.8861431	.7678877	.9859674	.2459249
.1100185	.7523098	.0387286	.8410738	.1342213	.7776624	.2078029	.9753584
.8162183	.0272849	.4106072	.3250962	.7370280	.1285043	.0630326	.8790774
.1424900	.8112515	.4064430	.8053689	.6711154	.8894297	.1787127	.3390880
.3318185	.4773176	.6647042	.0880304	.0038059	.4757344	.4668019	.3502432
.6895318	.1914800	.9350022	.8752769	.4096173	.2021570	.2696246	.7030698
.2841714	.5214285	.1785654	.3206702	.0837761	.4720133	.0016623	.2077818
.7635107	.4389415	.8551911	.8988911	.3613879	.1734906	.6863279	.7909816

[1] Zone 7 is chosen as an example. The process was followed for selection of states within each zone.

[2] The random numbers presented here represent an excerpt from a table generated using Supercalc®[3] software from the Sorcim/IUS Corporation (Sorcim/IUS Micro Software, Release 2, August, 1984).

Figure 3. Example of Process Used for Selection of States Within Zones.[1]

that adherence to the site selection strategy was high. However, problems of site identification, inaccessibility, and scheduling caused shortfalls of randomly selected drill sites in Zone 10 and Zone 11. (Zone 10 and Zone 11 were each missing one randomly selected drill site.) Two randomly selected production sites were sampled in each zone, with the exception of Zone 5, and Zone 6 (see Table 5). For a discussion of assignment of second production samples, see Appendix B.

Specific site selection. One drill site was specifically selected in each of Zones 7, 10, and 11 (see Table 5). In Zone 7, one drill site was specifically selected because the random site selection process missed Oklahoma, a state with more drilling activity than most entire zones. In Zone 10 and Zone 11, circumstances of site availability, scheduling, and accessibility compelled specific selection of one drill site in each zone.

One production site was specifically selected in Zone 7 and three sites were specifically selected in Zone 4 (see Table 5). In Zone 7, one production site was specifically selected because the random site selection process missed Oklahoma, a state with considerable oil and gas production.

Specialty sites, including tank bottom sludges, centralized pits, and centralized treatment facilities are also shown in Table 5.

Table 5. Distribution of Probability Sites and Specifically-Selected Sites Among Zones.

	NO. PROBABILITY SITES			NO. SPECIFIC SITES					
Zone	Drill	Prod.	T.B.	Drill	Prod.	T.B.	Cent. Pit	Cent. Trtmt.	TOTAL
2	2	2	1	-	-	-	-	1	6
4	2	2	-	-	3	-	-	1	8
5	2	1	-	-	-	-	-	-	3
6	2	1	-	-	-	-	-	-	3
7	2	2	-	1	1	-	1	-	7
8	2	2	-	-	-	-	1	-	5
9	2	3	-	-	-	-	2	-	7
10	1	2	-	1	-	1	-	-	5
11	1	2	-	1	-	-	-	1	5
TOTAL	16	17	1	3	4	1	4	3	49

Abbreviations: Drill - drill site
Prod. - production site
T.B. - tank bottom sludge site
Cent. Pit - centralized pit site
Cent. Trtmt. - centralized treatment site

Sampling Activities

Sampling was conducted from June through September 1986. The itinerary is presented in Table 6. Trip reports were written for each site sampled. Trip reports include site identification, status during sampling, description, plot plan, sampling information, and other technical information. Technical details are included in Appendix C. Sampling protocols are described in the QUALITY ASSURANCE AND QUALITY CONTROL section of this report, and in Appendix G.

Selection of Analytes

The analytes selected for testing in this Project were those on various regulatory lists or those specific to characterization of this industry. The regulatory lists from which the pollutants were taken are the:

Priority Pollutant List [NRDC vs Train, 8 ERC 2120 (DDC1976)]

Priority Pollutant Appendix C List [ibid.]

RCRA 40 CFR Part 261 Appendix VIII List [50 FR 1999]

Michigan List [49 FR 49793]

Superfund Hazardous Substances List

Analytes to be added to the RCRA Appendix VIII List (EPA memo from Robert April to Marcia Williams, 20 Dec 85)

Paragraph 4(c) List (NRDC vs Train, op. cit.; high priority compounds detected in wastewaters)

ITD List (analytes specific to ITD programs)

The list of analytes tested for in this Project is given in Appendix F. This list covers all conventional pollutants (e.g.,

Table 6. Itinerary of Sampling Activities

Date	Location	Operator
June 12, 1986	Mobile, AL	Separation and Filtration Enterprises, Inc.
June 14, 1986	Plaquemines Parish, LA	Freeport-McMoran and Partners Operating Co.
June 16, 1986	St. Mary Parish, LA	Sun Exploration and Production Co.
June 17, 1986	Pointe Coupee Parish, LA	Westland Oil Development Corporation
June 17, 1986	Iberville Parish LA	Mobil Oil Exploration and Producing Southeast Inc.
June 19, 1986	Wood County, TX	Exxon Company, USA
June 20, 1986	Talco, TX	Mobil Producing Texas and New Mexico Inc.
June 23, 1986	Wheeler County, TX	Murexco Petroleum, Inc.
June 24, 1986	Wheeler County, TX	Chevron USA, Inc.
June 25, 1986	Bloomfield, NM	Basin Disposal, Inc.
June 26, 1986	San Juan County, NM	Amoco Production Co.
June 26, 1986	Grady County, OK	Ward Petroleum Corporation
June 27, 1986	Lea County, NM	Cities Service Oil and Gas Corporation
June 27, 1986	Oil Center, OK	George Kahn Operating Co.
June 29, 1986	San Juan County, UT	Meridian Oil Co.
June 29, 1986	McClain County, OK	Royce Kelly Disposal
June 30, 1986	San Juan County, UT	Marathon Oil Co.
July 2, 1986	Montgomery County, KS	Cindy Van Dyke
July 2, 1986	Uintah County, UT	Wexpro Company
July 7, 1986	Hays, KS	Damar Resources Incorporated

Table 6 (Cont'd). Itinerary of Sampling Activities

Date	Location	Operator
July 7, 1986	Pendennis, KS	American Energies Corp.
July 9, 1986	Golden Meadows, LA	
July 11, 1986	Greeley, CO	E-Vap, Ltd.
July 13, 1986	Gillette, WY	Diamond Shamrock Exploration Company
July 14, 1986	Casper, WY	Amoco Production Co.
July 14, 1986	Oxnard, CA	Sun Exploration and Production Co.
July 15, 1986	Uinta County, WY	Waste, Incorporated
July 15, 1986	Ventura, CA	Shell California Production, Inc.
July 16, 1986	Mountain View, WY	Sun Exploration and Production Co.
July 16, 1986	Kern County, CA	McFarland Energy, Inc.
July 16, 1986	Kern County, CA	Shell California Production, Inc.
July 29, 1986	Jackson County, MI	Wolverine Gas and Oil Company, Inc.
July 30, 1986	Gladwin County, MI	Sun Exploration and Production Co.
July 31, 1986	Hillsdale County, MI	Powell Production, Inc.
August 1, 1986	North Slope, AK	Sohio Alaska Production Co.
August 2, 1986	North Slope, AK	Sohio Alaska Production Co.
August 3, 1986	North Slope, AK	ARCO Alaska, Inc.
August 7, 1986	Cook Inlet, AK	Marathon Oil Co.
August 8, 1986	Kanai, AK	Union Oil Co. of California
August 18, 1986	Leeville, LA	

Table 6 (Cont'd). Itinerary of Sampling Activities

Date	Location	Operator
August 19, 1986	Jane Lew, WV	Scott Oil Company
August 21, 1986	Henderson County, KY	Maverick Production, Inc.
August 22, 1986	Hopkins County, KY	Ecus Corporation
Sept. 3, 1986	Franklin, PA	Franklin Brine Treatment Corporation
Sept. 4, 1986	Venango County, PA	Mark Resources Corporation
Sept. 29, 1986	Leeville, LA	

BOD_5 and TSS) and metals; and it does not list every individual organic compound. Specifically, major organic analyses and classes of the tetra- through octa-chlorodibenzo-p-dioxins and furans (136) are not listed. The analytical methods employed in this Project for groups of analytes are summarized in Table 7. This table is divided into three categories: organic analytes are specific chemical compounds based on carbon chemistry; metals are chemical elements (substances that cannot be divided without altering their physical and chemical properties); conventional pollutants are, for the most part, chemical substances that have been historically used to assess the performance of water treatment plants (drinking water and sewage) and for assessing water quality. Other analytes included in the conventionals category are those that test for substances as a group, rather than as a single chemical compound. For example, the retort test determines the amount of oil in a mud sample.

-- Organic compounds on the List of Analytes in Appendix F are typified by normal-, polynuclear-, and chlorinated hydrocarbons; metals are typified by mercury arsenic, and selenium; conventional pollutants are typified by ammonia, total dissolved solids, sulfides, and oil and grease.

The organic and metals analytes are further subclassified according to the analytical method employed in this Project. "Volatiles" is that fraction of the organic analytes which is purged from the waters and sludges for determination by GCMS;

Table 7. Summary of Analytes

	Number of Analytes	
Organics		
Volatiles by GCMS		
Isotope dilution	32	
Reverse search	23	
Semi-volatiles by GCMS		
Isotope dilution	82	
Reverse search	94	
Dioxins and furans by GCMS	136	
Pesticides by GC		
Electron capture detector (ECD)	39	
Flame photometric detector (FPD)	35	
Herbicides by GC/ECD	3	
Total organics		444
Metals		
Atomic absorption	6	
Calibrated Inductively Coupled Plasma (ICP)	21	
ICP screening	41	
Total metals		68
Conventionals by wet chemistry		19
RCRA (Corrosivity, Ignitability, Reactivity)		3
Total number of analytes		534

"semi-volatiles" is that fraction extracted from waters and sludges for determination by GCMS.

In Appendix F, the analytes are listed by (1) Chemical Abstracts Service Registry Number (CAS NO) and by (2) ANALYSIS TYPE. A legend for the list in Appendix F and the rationale for pollutant selection are given as a preface to the list.

Chemical Analyses

Samples were tested by laboratories using EPA analytical methods. Nearly all of these methods are either approved wastewater methods (CWA 304(h)), proposed or approved methods for testing wastes (RCRA SW-846, TCLP), or Superfund Contract Laboratory Program methods. The methods used form Appendix D and are summarized in Table 8. In selecting between available methods, EPA chose methods that it believed would produce results meeting Project requirements. The SW-846 and 304(h) methods were drawn upon most heavily because of their direct applicability to the samples that were expected to be encountered. Other considerations were:

(1) EPA's experience in managing laboratories using a given method or method set. For example, EPA has used Methods 1624 and 1625 in testing untreated and treated wastewaters and in-process streams from a diversity of industries since 1980 and thus has extensive experience in applying the methods to samples containing the complex mixtures of organic compounds that were anticipated in the Project.

(2) Having contracts in place that would permit the analyses to be performed in accordance with the Project schedule. At the time of Project inception, ITD had in place contracts for testing the organic, metal, and inorganic analytes required for this Project. Alternate methods would have necessitated contract modifications or award of new contracts.

Table 8. List of Analytes, Matrices, Fractions, and Methods for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Project

(1) Analysis Category	(2) Matrix	(3) Fraction	(4) Analysis Technique	(5) Method	(6) Modification
Organics	Water	Pesticide	GCEC	1618	
			GCFPD	1618	
		Herbicide	GCEC	1618	
		Volatiles	GCMS	1624C	
		B/N	GCMS	1625C	
		Acid	GCMS	1625C	
		Diox/Furan	HRGCLRMS	613M	Cl_4 to Cl_8
			HRGCLRMS	8280	High res. MS
	Sludge	Pesticide	GCEC	1618	
			GCFPD	1618	
		Herbicide	GCEC	1618	
		Volatiles	GCMS	1624C	
		B/N	GCMS	1625C	
		Diox/Furan	HRGCHRMS	8280M	High res. MS
Org/TCLP		-------------Same as for waters-------------			
Metals	Water	Mercury	CVAA	245.5	
		Furnace	FURNAA		
			Sb	204.2	
			As	206.2	
			Se	270.2	
			Ag	272.2	
			Tl	279.2	
		ICP	ICP	200.7M	+ 42 Element screen
	Sludge	Mercury	CVAA	245.5M	CLP
		Furnace	FURNAA	3020	
			Sb	204.2M	CLP
			As	206.2M	CLP
			Se	270.2M	CLP
			Ag	272.2M	CLP
			Tl	279.2M	CLP
		ICP	ICP	200.7M	+ 42 Element screen + HCl if nec.
Met/TCLP		-------------Same as for waters--------------			

Table 8 (Cont'd). List of Analytes, Matrices, Fractions, and Methods for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Project

(1) Analysis Category	(2) Matrix	(3) Fraction	(4) Analysis Technique	(5) Method	(6) Modification
Conventional	Water	Ammonia	Electrode	350.3	
		BOD$_5$	Probe	405.1	
		Chloride	Ion chrom.	300.0	
		Chlorine	Color.		Field test
		COD	Color.	410.4M	Saline
		Cyanide	Distill.	335.2	
		Fluoride	SPADNS	340.1	
		Nitrate/ nitrite	Ion chrom.	300.0	
		pH (field)	Paper	--	
		(lab)	Electrode	150.1	
		Oil & gr.	Grav.	413.1	
		Residue	Grav.-TDS	160.1	
			-TSS	160.2	
			-Tot.	160.3	
		Specific conduct.	Wheatstone bridge	120.1	
		Sulfide	Titr.	376.2	
		TOC	Combust.	415.1	
		TVO	TOC	415.1M	Purge & trap
	Sludge	Ammonia	Electrode	350.3	
		BOD$_5$	Probe	405.1	
		Chloride	Ion chrom.	300.0	
		COD	Color.	410.4M	Saline
		Cyanide	Distill.	335.2	
		Fluoride	SPADNS	340.1	
		Nitrate/ nitrite	Ion chrom.	300.0	
		pH (field)	Paper	--	
		(lab)	Electrode	150.1	
		Oil & gr.	Grav.	413.1	
		Oil & gr.	Retort	--	
		Residue	Grav.-Tot.	160.3	
		Sulfide	Color.	376.2	
		TOC	Combust.	9060	
		TVO	TOC	415.1M	Purge & trap
Haz. waste	Sludge	Ignit.		1010	
		Corrosiv.		1110	
		React.		SW-846	

Table 8 (Cont'd). List of Analytes, Matrices, Fractions, and Methods for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Project

Notes:

(1) Analysis category - general category into which analytes can be classified.

Organics - carbon based chemical compounds. The list of these compounds can be found on the ITD/RCRA List of Analytes.

Organics/TCLP - organic compounds leached from sludge and sediment using the RCRA Toxicity Characteristic Leaching Procedure.

Metals - elements found on the ITD/RCRA List of Analytes.

Metals/TCLP - metals leached from sludge and sediment using the TCLP.

Conventional - conventional wastewater chemistry analytes.

Hazardous waste characteristics - RCRA analytes which determine if a waste is hazardous. The TCLP has been proposed to replace the current EP Toxicity procedure.

(2) Matrix - the nature of the sample.

Water - produced water, runoff water, or other sample which is nearly all water.

Sludge - tank bottoms, drilling muds, or other sample which contains a significant quantity of solids (normally greater than 1 percent).

(3) Fraction - a means of further categorizing the sample for purposes of analysis.

Volatile - volatile organic compounds analyzed by GCMS.

B/N - base/neutral organic compounds analyzed by GCMS.

Acid - organic acids analyzed by GCMS.

Diox/Furan - chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans.

TVOC - total volatile organic carbon.

Table 8 (Cont'd). List of Analytes, Matrices, Fractions, and Methods for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Project

Furnace - metals analyzed by furnace atomic absorption spectrometry.

ICP - metals analyzed by inductively coupled spectrometry.

BOD_5 - biochemical oxygen demand.

COD - chemical oxygen demand.

Oil and gr. - oil and grease.

Specific conduct. - specific conductivity.

TOC - total organic carbon.

Ignit. - hazardous waste characteristic of ignitability.

Corrosiv. - hazardous waste characteristic of corrosivity.

React. - hazardous waste characteristic of reactivity.

(4) Analysis technique

GCEC -gas chromatography combined with an electron capture detector.

GCFPD - gas chromatography combined with a flame photometric detector.

GCMS - gas chromatography combined with a mass spectrometer detector.

HRGCLRMS - high resolution gas chromatography combined with low resolution mass spectrometry.

HRGCHRMS - high resolution gas chromatography combined with high resolution mass spectrometry.

TOC - total organic carbon analyzer.

CVAA - cold vapor atomic absorption spectrometry.

FURNAA - furnace atomic absorption spectrometry.

Ion chrom. - ion chromatography.

Color. - colorimetric.

Table 8 (Cont'd). List of Analytes, Matrices, Fractions, and Methods for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Project

Titr. - titrimetric.

Distill. - distillation.

SPADNS - distillation followed by calorimetric.

Grav. - gravimetric.

TDS - total dissolved solids.

TSS - total suspended solids.

Tot. - total solids.

Retort - the platform operator's method of determining the oil content of a sample from a well.

(5) Method - the EPA method number.

Water methods are three-digit numbers (some include a decimal).. ITD methods are 1618, 1624C, and 1625C. Office of Solid Waste SW-846 methods are all other four-digit numbers.

(6) Gives a modification to the method.

Cl_4 to Cl_8 - Samples were screened for all tetra- through octa-isomers of chlorinated dibenzo-p-dioxin and dibenzofuran.

High res. MS - high resolution mass spectrometer was used in place of low resolution instrument to gain specificity.

+ 42 element screen - search of a specific ICP wavelength for 42 metals in addition to the 27 determined by calibration and search.

CLP - method modified for application to solids by the Superfund Contract Laboratory Program.

Purge & trap - volatiles are purged from water or sludge.

+ HCl if nec. - hydrochloric acid added to aid in digestion of organic sludges if necessary.

Field test - test performed in at the site.

Saline - Hach method 8000.

(3) Application of these methods to analysis of samples from the offshore oil and gas extraction industry. In 1981, ITD used Methods 1624 and 1625 for analysis of samples collected from produced waters on offshore oil platforms and was therefore familiar with the problems likely to be encountered with these samples. Although other methods might have been applicable, EPA desired to take advantage of its experience with methods that had been demonstrated to work on the complex matrices involved.

(4) Quality assuring results with these methods. ITD has in place a computerized system for quality assuring results from analysis using Methods 1624 and 1625. Although it would have been possible to apply the QA system to analysis of the same list of organic analytes using SW-846 or Superfund CLP methods, ITD had extensive experience with the quality assurance system using Methods 1624 and 1625, and would have had to proof-test the QA system with alternative methods prior to their use.

Methods used cover many analytes of importance not only to EPA Solid Waste Programs but to all of EPA. In late 1985, EPA became concerned that the growing number of pollutants on a growing number of lists presented a formidable analytical challenge. As a result, EPA created "The 1986 List of Lists," a computer listing containing the analytes considered by EPA and a state program office to be of concern. This list also contained information about the origin of the analyte; the Chemical Abstracts Service (CAS) registry number where it was known; the regulatory, common, and CAS name for the analyte; the analytical method that EPA either knew or estimated could be used for determination of the analyte; and other technical data specific to the analysis of the analyte.

Lists of analytes that do not commonly occur in Agency regulations and the reason for method selection for determination of these analytes are:

(1) The Appendix C List. In the 1976 Consent Decree and its subsequent amendments, the Court directed the Agency to study the environmental hazards created by certain other substances not on the original list of 65 substances. These are listed in Appendix C to the Consent Decree and include the normal hydrocarbons. Normal hydrocarbons do not appear on the RCRA Appendix VIII list, but were known by ITD to be the most prevalent pollutants produced by the oil and gas extraction industry. EPA has used Methods 1624 and 1625 to monitor for the normal hydrocarbons and other organic Appendix C pollutants for more than four years and, therefore, has extensive experience with testing for these pollutants with these Methods.

(2) The Paragraph 4(c) List. Paragraph 4(c) of the Consent Decree required EPA to test wastewaters for other pollutants, to consider adding the pollutants it found to the list it regulates, and to begin testing for these pollutants in its monitoring programs. EPA has been testing for the high priority pollutants detected in the paragraph 4(c) study for more than three years using Methods 1624 and 1625 and, therefore, has extensive experience in testing these pollutants using these Methods.

(3) The RCRA Appendix IX Groundwater Monitoring List. This list was revised on 20 December 1985 based on the results of a meeting between Office of Water, Office of Solid Waste, Office of Solid Waste and Emergency Response, Office of Research and Development, and EPA Regional and Environmental Monitoring Laboratory personnel. EPA incorporated the revised list into the list of analytes for which it planned to test, and began collecting test data on methods appropriate for these analytes.

(4) The Michigan List. The Michigan Petition [49 FR 49793] petitioned EPA to add 120 substances to the RCRA Appendix VIII List. Many of the substances on this list were pesticides for which SW-846 methods did not exist. EPA incorporated this list into its analytical programs, and collected test data on methods for these analytes.

After creating "The List of Lists," EPA engaged analytical experts to select the substances that could be analyzed using known methods. This process was biased toward positives, i.e., if there was doubt about an analyte, it was retained. EPA then applied certain editing rules to the list to produce "The 1986 Industrial Technology Division List of Analytes" (the "ITD List"). The editing rules related mainly to the availability of an analytical method, the source for an analytical standard for the analyte, the stability of the analyte in water, and other technical considerations. After editing, the Agency developed or modified test methods for untested analytes on the ITD List in contract laboratories. EPA then revised the ITD List to reflect the results of this testing, e.g., if an analyte could be recovered from water, it remained on the list; if not, it was removed. This process also determined the precision and recovery for an analyte in a contract laboratory. Therefore, through the process of listing, editing, and testing, EPA maximized the number of pollutants that the Agency was to determine and we knew the performance characteristics of the methods that we chose for this Project.

Some methods were extended to cover an extended list of analytes. For example, Methods 1624 and 1625 were extended to cover the organic compounds on the RCRA Appendix VIII and IX Lists (50 FR 1999 and 41 FR 26639, respectively), where it was demonstrated feasible to test for a given analyte. ITD tested these analytes using Methods 1624 and 1625 prior to Project inception and therefore knew the accuracy and precision that could be expected for these compounds prior to application of these methods.

Nearly all methods employed were EPA (ITD, 304(h), CLP, or SW-846) or Standard Methods. The exceptions are methods for pH using paper, for chlorine using the Coastal kit, and for the Oil and Grease test which employs the IMCO Retort, for which no EPA or Standard Method is available. The IMCO Retort is the oil and gas extraction industry operator's method for determining the oil content of drilling fluids.

Data Collection and Analysis

Data Reporting and Validation

Data from the analytical tests were reported to the Sample Control Center (SCC). A description of the operation of the Sample Control Center is given in Appendix E. Data were received in one of three forms:

(1) Gas chromatography/mass spectrometry (GCMS) data from analysis of the volatile and semivolatile GCMS fractions of the organic compounds were received on IBM compatible 9-track magnetic tape. After tape log-in and the assignment of a tape number, the tapes were shipped to EPA's National Computer Center (NCC) in Research Triangle Park, North Carolina. The tapes were mounted and read into the IBM mainframe computer, and the data contained on the tapes were accessed by terminal from the Sample Control Center. Tape processing consists of three steps involving three levels of testing. After processing, the data, including the quality assurance data, were placed in a Statistical Analysis System (SAS) Data Set so that these data could be accessed by SRI International (SRI) for statistical evaluation.

(2) Metals and conventional pollutants data were received on a floppy diskette in Lotus format. The data were printed for review, and a copy of the diskette was forwarded to SRI. Upon receipt by SRI International, the data were read from the floppy disk into a personal computer and uploaded into the NCC IBM mainframe. Corrections to data were made by phone between SCC, SRI, and the laboratory.

(3) Metals and conventional pollutants QA data, pesticide/herbicide data, and dioxin/furan data were received in hard copy form. These data were reviewed, discrepancies were resolved with the laboratories, and corrected copies were shipped to SRI for encoding into the NCC IBM mainframe.

Data Base Construction

Analytical data were received by SRI in three forms: (1) a Statistical Analysis System (SAS) database on the NCC IBM mainframe containing data for organics, (2) a Lotus 123 spreadsheet with conventionals, metals (including the 27 ITD metals, 42 metals by Inductively Coupled Plasma (ICP) screening, and 27 ITD metals in the TCLP analysis of sludges), and (3) hardcopy data for dioxins/furans, pesticides, and salinity. Table 9 and Table 10 present a summary of liquid samples and solid samples, respectively, analyzed by site, location, and analyte grouping (i.e., conventionals, metals, organics). These tables also illustrate the structure of the data base.

Organics Data Reduction

To produce the most accurate results, the methods for analysis of organic compounds (Methods 1624 and 1625) require that the sample be diluted and reanalyzed when the concentration of any analyte exceeds the analytical range of the instrument. This requirement can result in multiple concentrations for a given analyte in the series of dilutions performed. For multiple concentration/dilution runs for each sample fraction (acid, base/neutral, combined acid/base/neutral, or volatile), the concentration for each organic analyte was reduced to the single most accurate value. This process was performed by computer using logic that selects the most accurate value for the pollutant, regardless of the number and magnitude of the dilutions. This logic was structured as follows:

Table 9. Number of Liquid Samples Analyzed

Site	Location	Conventionals[1]	Metals[2]	Organics[3]	Pesticides[4]	Dioxin[5]
Central Pit	Central Pit	4	4	4	2	-
Central Treatment	Effluent	3	3	3	3	2
	Influent	2	2	2	2	2
	Tank	-	-	-	-	-
Drilling	Pit	17	17	16*	2	-
	Tank Bottom	1	1	-	-	-
	Drilling Mud	-	-	-	-	-
Production	Endpoint	21	24	21	-	2
	Midpoint	3	3	5	-	-
	Tank Bottom	-	-	-	-	-

---

[1] Conventional and RCRA pollutants, by applicable EPA methods.

[2] Metals, by applicable methods (AA, ICP, Superscan).

[3] Organic pollutants, by EPA Method 1624C (volatiles) and 1625C (non-volatiles).

[4] Pesticides, by EPA Method 1618.

[5] Dioxins and furans, by EPA Method 613 (one sample analyzed by high-resolution GCMS).

*One sample analyzed for volatile organics as solid phase.

Table 10. Number of Solid Samples Analyzed

Site	Location	Conventionals[1]	Metals[2]	Organics[3]	Pesticides[4]	Dioxin[5]	TCLP Metals[6]	TCLP Organics[7]
Central Pit	Central Pit	3	3	3	1	2	3	3
Central Treatment	Effluent	3	3	3	2	4	3	3
	Influent	1	1	1	1	1	1	1
	Tank	2	2	2	-	-	2	1
Drilling	Pit	21	21	18	5	4	21	18
	Tank Bottom	-	-	1	-	-	1	1
	Drilling Mud	1	1	2	-	-	1	2
Production	Endpoint	-	-	-	-	-	-	-
	Midpoint	-	-	-	-	-	1	1
	Tank Bottom	1	1	1	2	-	1	1

---

[1] Conventional and RCRA pollutants, by applicable EPA methods.
[2] Metals, by applicable methods (AA, ICP, Superscan).
[3] Organic pollutants, by EPA Method 1624C (volatiles) and 1625C (non-volatiles).
[4] Pesticides, by EPA Method 1618.
[5] Dioxins and furans, by high-resolution GCMS.
[6] Metals in TCLP extract.
[7] Organic pollutants in TCLP extract.

Metals Data Reduction

The laboratory performing analyses for metals estimated the detection limit in each sample for the 27 metals on the ITD list. For the 42 metals determined by Inductively Coupled Plasma (ICP) screening, the laboratory provided a list of detection limits in water. This list was entered into the NCC IBM mainframe. The detection limit for the 42 metals determined by ICP screening in solid samples was calculated based on the detection limit in water, corrected for the percent solids content of the solid samples. These detection limits were used for the data reported in Appendix A.

Hardcopy Data Entry

The hardcopy data were coded twice and compared, with differences resolved by reference to the printed data. Questionable values were clarified through SCC with the analytical laboratories. Finally, the data coding was spot checked to ensure accuracy.

The hardcopy and Lotus data were uploaded to NCC using an error-checking file transfer program. The data were read into SAS and divided into three data sets: the first contained results for pollutants in EPA samples; the second contained results for surrogates, matrix spikes, and duplicates in EPA samples; the third contained QA/QC results, including calibration and ongoing precision and recovery results. The results for samples were merged with information on site types, sample locations, and other sampling and logistics information, so that statistical analyses could be applied to common site types and to preclude unfounded data pooling. Table 11 contains the list of variables and values in the three data sets.

Statistical Testing

Statistical analyses of the data were performed using the Statistical Analysis System (SAS) package resident on the EPA NCC IBM computer. Details of the statistical tests performed are given in the RESULTS AND CONCLUSIONS section of this report.

Table 11. Database Variables and Values

Variable	Contents	Codes	Values
PLANTID	Plant ID	xx	Randomly assigned two-digit plant ID
STATE	State	aa	2-letter state abbrev.
SAMPDATE	Sampling Date	date	
SAMPLE	EPA Sample #	xxxxx	
EPISODE	Episode Number	xxxx	
PHASE	Sampling Phase	L	Liquid
		S	Solid
EXTRACT	Extraction	D	Direct
		T	TCLP
LAB	Laboratory ID No.	xxx	
ANALDATE	Analysis Date	date	
SAMTYPE	Sample Type	EPA	Field Sample
		BLK	Blank
		FBK	Field Blank
		CAL	Calibration
		IPR	Initial Precision and Recovery
		OPR	Ongoing Precision and Recovery
		MS	Matrix Spike
		MSD	Matrix Spike Duplicate
METHOD	Analytical Method	CONVEN	Conventional and RCRA poll. methods
		METALS	AA, ICP, etc.
		SALINI	Salinity
		SS	SuperScan (Metals)
		1624C	EPA Method 1624C (Volatile Organics)
		1625C	EPA Method 1625C (Non-volatile Organics)
		1618	EPA Method 1618 (Pesticides)
		DIOXIN	[U.S. Testing's dioxin method]
		HIRES	High-Resolution GCMS (Dioxin)
CMPD	Extended CAS#	nnnnn	See Appendix F
[with compound	number list]		
CHOICE	Sampling Choice	D	Directed
		R	Random
WATER	Produced Water Volume	x.x	barrels/day

Table 11 (Cont'd). Database Variables and Values

Variable	Contents	Codes	Values
LIQUID	Total Liquid Pit Waste[2]	x.x	bbl.
SLUDGE	Total Liquid Pit Waste[2]	x.x	bbl.
AMOUNT	Measured Concentration	x.x 0 = not	Units given by UNITS detected
AMTQUAL	Qualifier	< ND	Less than detection limit Not detected
DETLIMIT	Detection Limit	x.x	
UNITS	Units	mg/L, etc.	Concentration
		%	Percent
		degF	Degrees F
		pH	H+ as pH
		umho/cm	Conductivity
		S(-/+)	S reactivity[1], 0=no, 1=yes
SITETYPE	Site Type	P	Production
		D	Drilling
		CP	Central Pit
		CT	Central Treatment
SAMPLOC	Sampling Location	INF	Influent
		EFF	Effluent
		MP	Midpoint
		EP	Endpoint
		PIT	Pit
		CP	Central Pit
		TB	Tank Bottom
		TNK	Tank Sample
		LDF	Landfill
		DM	Drilling Mud

[1] CN reactivity was tested in the same samples, but was never found.

[2] Estimated at completion of drilling.

QUALITY ASSURANCE AND QUALITY CONTROL (QA/QC)

Project Organization and Objectives

The Project organization chart is shown in the PROJECT DESCRIPTION section of this report. Project quality assurance (QA) is organized as shown in Figure 4. The Project QA Officer is Mr. William A. Telliard, who has responsibility for all aspects of the sampling and analysis, and is ultimately responsible for the quality of the results.

All sampling for the project was performed by CENTEC Corporation under the "Sampling Plan and Sampling Quality Assurance/Quality Control Plan" in Appendix G.

Quality of laboratory analyses was assured by the quality assurance department in each individual laboratory. Results from each laboratory were further quality assured by the EPA Sample Control Center under the supervision of Mr. James King.

Data Quality Objectives

Data quality objectives are normally stated as "to produce data with the highest quality possible." Because such objectives do not take into consideration the quality which is known to be achievable given time and resource constraints, a more practical approach based on experience with what can actually be achieved was adopted. This approach was to use experienced systems for sampling, testing, logistics, and

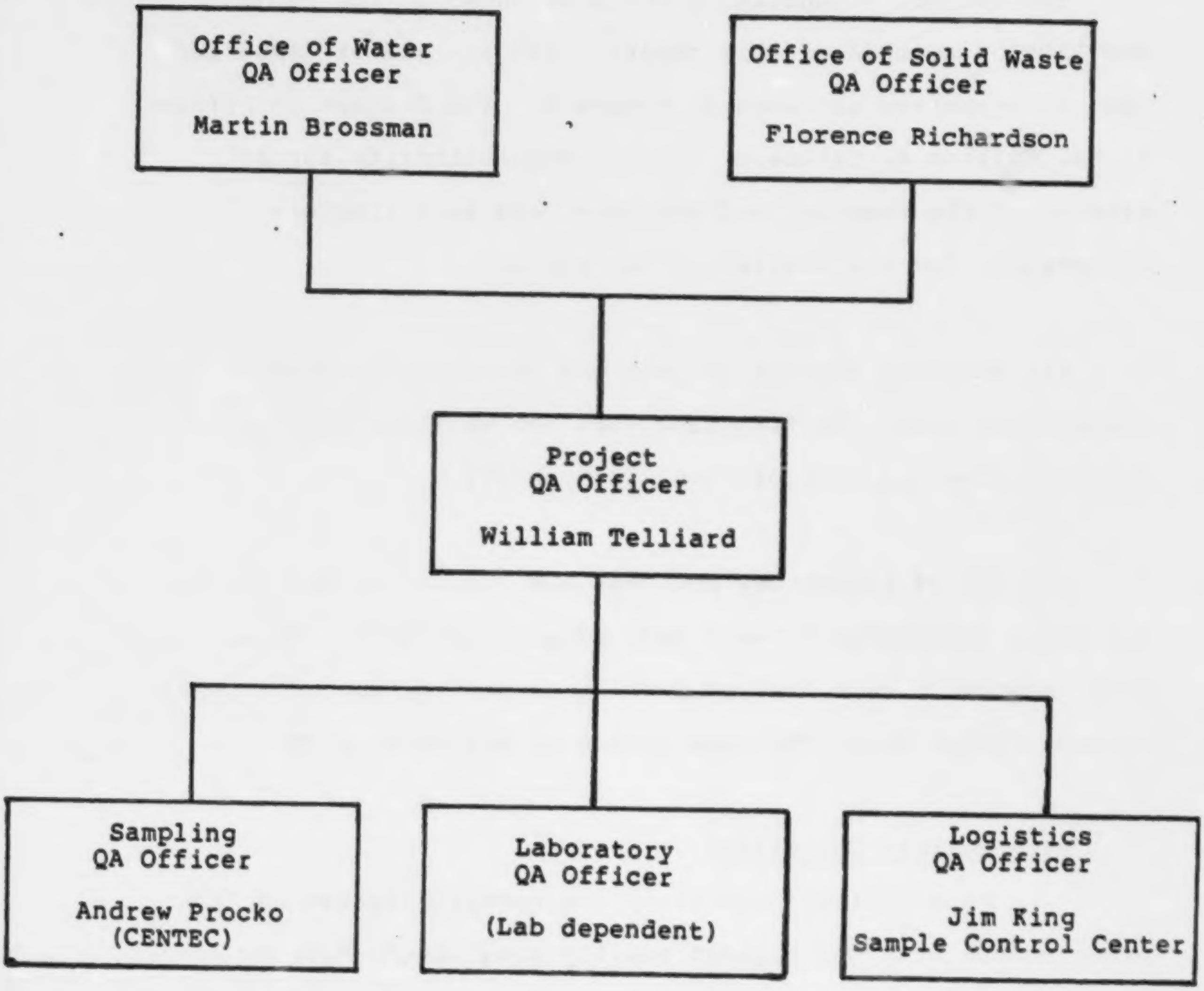

Office of Water
QA Officer
Martin Brossman
Office of Solid Waste
QA Officer
Florence Richardson
Project
QA Officer
William Telliard
Sampling
QA Officer
Andrew Procko
(CENTEC)
Laboratory
QA Officer
(Lab dependent)
Logistics
QA Officer
Jim King
Sample Control Center

Figure 4. QA/QC Management Organization

statistical analysis, and to control these systems within known, well-defined limits.

For laboratory testing, the overriding objective was to ensure that the data produced met or exceeded known precision and accuracy measures for the analyses performed. These requirements are defined in the analytical methods used and are in the forms of spike recoveries, differences between duplicates, and statements of data quality, expressed as confidence limits. The "Quality Control Analyses" subsection of the RESULTS AND CONCLUSIONS section of this report gives a data quality statement for each analyte where these data are available, and for surrogate analytes where it was not possible to test every analyte (chlorinated dioxins and furans, for example).

By using well-established systems with well-defined operating limits for all parts of the Project, data quality objectives became an integral part of Project objectives. Table 12 summarizes the data quality objectives (DQOs) for this Project. For analytes tested by isotope dilution using Methods 1624 and 1625, the DQOs are specific to each analyte. The reader is referred to Tables 6 and 10 of Methods 1624 and 1625, respectively, for DQOs for the analytes tested by isotope dilution (114) using these methods.

Table 12. Data Quality Objectives for the Exploration, Development, and Production of Crude Oil and Natural Gas Field Sampling and Analysis Praject

Analyte or Fraction	Precision RSD (2)	Accuracy (3)	Completeness
Organics			
Volatiles by GCMS			
Isotope dil.	(4)	(4)	> 95 %
Reverse search	25% (5)	50-150% (5)	> 95 %
Semi-volatiles			
Isotope dil.	(4)	(4)	> 95 %
Reverse search	25% (5)	50-150% (5)	> 95 %
Dioxins and furans			
2,3,7,8-TCDD	25%	75-125%	> 95 %
Others	50%	50-200%	> 95 %
Pesticides			
Chlorine by ECD	20%	50-120%	> 95 %
Phos. by FPD	20%	70-120% (6)	> 95 %
Herbicides	30%	30-100%	> 95 %
Metals			
Atomic absorption	20%	80-120%	> 95 %
ICP	20%	80-120%	
Calibrated	10%	90-110% (7)	> 95 %
Screening	30%	50-150%	> 95 %
Classicals	25%	80-125% (8)	> 95 %

Notes:

(1) Methods and sample matrices are given in Table 5; experimental details are given in Appendix D.

(2) Relative standard deviation (coefficient of variation).

(3) Expected maximum deviation from true value, except where noted.

(4) Analyte specific; see Tables 6 and 10 in Methods 1624 and 1625, respectively.

(5) Average limits for precision and accuracy. Limits are analyte dependent. Worst case limits range to 70% RSD for precision and 10-300% for accuracy.

(6) TEPP, Methyl parathion, and Dichlorovos 40-120%; trimethyl phosphate 25-100%.

(7) Tin: 80-120%.

(8) pH, BOD, and Oil and Grease: 70-130%.

Representativeness

The representativeness of the data produced in this Project is dependent mainly on the representativeness of the sampling and the purity and authenticity of the standards used in the laboratories. The details of sampling are described in the "Sampling Strategy" and "Sampling Reports" in Appendices B and C, respectively. The authenticity and purity of the standards used in the laboratories is specified in the methods. That authentic and pure standards were used is evidenced by the acceptability of laboratory audits which use blind tests for proper identification and quantification of analytes. The laboratories used for this project were found to produce acceptable results in all audits conducted in 1986. A summary of these audits is given in the "Performance and System Audits" subsection of this report.

Information Flow and Project Scheduling

Communications concerning sampling between the Project and the EPA Regions, the States, and Oil and Gas Industry were controlled by the EPA Project Officer. Information flow related to sampling, sample analysis, data reporting, data validation, and statistical analysis was controlled by the Sample Control Center. The flow of information and scheduling of Project activities were documented through the Sampling Reports in Appendix C and the various documents used by the Sample Control Center, as described in Appendix E.

Contracts were in place for the sampling, analysis, data review, and statistical analyses prior to the start of the Project, and all Project activities had been audited in some way prior to Project inception and throughout its duration. For example, the Project Officer and the EPA Project QA Officer visited several sampling sites while samples were being collected, and visited each of the laboratories performing the analyses at least once during the period that tests were being performed. The objectives of these visits were to assure that the activities were being performed properly and according to schedule, and that communications between the various parts of the Project were being used to document problems and their solutions. Contract Work Assignments were issued prior to Project inception, and monthly status reports from the prime contractors were received by the Project Officer. A master status report was maintained by CENTEC. This report showed the samples collected and the tests scheduled. As data were reported by the laboratories, the master schedule was expanded to include the data status. The master status was quality assured by the Sample Control Center by cross comparison of results received with sample fractions collected and tests performed by the laboratories.

Sampling Quality Assurance/Quality Control

Summary of Sampling QA/QC

The objectives of the sampling portion of the Project were to collect technical information and samples at sample sites. All sampling activities were conducted in accordance with the Sampling Plan and Sampling Quality Assurance/Quality Control Plan given in Appendix G. This QA/QC plan has been specifically designed for this Project.

Sample Control and Tracking

The system for sample tracking is explained in detail in Appendix E. The tracking system is quality assured by correlation of sample numbers that are required to appear on the samples, Traffic Reports, Laboratory Chronicles, data sheets, magnetic tapes, magnetic disks, and all other entities relating to each sample.

Corrective Actions

Specifically addressed in Appendix G is a section designed to anticipate onsite variations in sample collection procedures. This section, entitled "Corrective Action," includes a prioritized list of sampling methods and equipment to be used for a given circumstance. Also, conditions are given that would warrant the relocation of selected sample points or the cancellation of sampling at a specific site. If any changes from standard field protocols were necessary, they are documented in a specific sampling report in Appendix C.

System Audits

System audits, as described in Appendix G, were conducted by EPA in the field at specific site locations. Field practices were examined by the EPA representative. Table 13 lists the sites where EPA audited sampling activities.

Analytical Quality Assurance/Quality Control

Sample Testing

Prior to contract start-up, laboratories under contract to ITD are required to have in place an extensive quality assurance program which will guarantee that the data produced will meet Agency requirements. The details of the QA requirements are contained in contracts with the laboratories. Copies of all analytical contracts issued by ITD are on file at the Sample Control Center and in the EPA Contracts offices. ITD and the Sample Control Center perform periodic laboratory audits to assure that all requirements are being met.

In addition to contractual requirements and periodic audits, quality assurance is an integral part of the analytical methods used by ITD. The methods used for this Project are given in Appendix D. Minimum QA requirements in these methods are 10 percent duplicates, matrix spikes (spikes into samples), and blanks. The entities used for analytical quality assurance are listed.

(1) Matrix spikes

Implemented by: (a) measuring the background concentration of the analyte in a portion of the sample, (b) preparing a standard solution of the analyte which, when spiked into the sample, will produce a concentration that is one to five times the background concentration, (c) adding the standard solution to a portion of the sample to produce this concentration, and (d) analyzing the sample.

Table 13. EPA System Audits of Field Sampling Activities

Operating Company	Site Location	Date (1986)	EPA Rep.
Separation & Filtration Enterprise, Inc.	AL	June 12-13	S. de Nagy
FMP Operating Co.	LA	June 14	S. de Nagy
Sun Exploration & Production Co.	LA	June 16	S. de Nagy
Westland Oil Development Corp.	LA	June 17	B. Telliard S. de Nagy
Mobil Oil	LA	June 17	B. Telliard S. de Nagy
Basin Disposal Inc.	NM	June 25	S. de Nagy
Amoco Production Co.	NM	June 26	S. de Nagy
Cities Service	NM	June 27	S. de Nagy
Diamond Shamrock	WY	July 13	S. de Nagy
Shell California Production, Inc.	CA	July 15	B. Telliard
McFarland Energy, Inc.	CA	July 16	B. Telliard
Standard Alaska Production Co.	AK	August 1	S. de Nagy
Standard Alaska Co.	AK	August 2	S. de Nagy
ARCO Alaska, Inc.	AK	August 3	S. de Nagy
Marathon Oil Co.	AK	August 7	S. de Nagy
Union Oil of CA	AK	August 8	S. de Nagy
Scott Oil Co.	WV	August 19	S. de Nagy

Quantities measured: recovery, expressed as percent; and after sufficient data have been accumulated, precision, expressed as relative standard deviation (coefficient of variation).

Purposes: (1) to determine if method is applicable to sample being tested, (2) to permit comparison between samples, (3) to evaluate the nature of the sample, (4) to permit generation of statements of data quality (precision and accuracy) for samples analyzed by the laboratory, (5) to determine if sample needs to be diluted to bring recovery within range considered normal for the sample, and (6) to permit separation of error sources between (a) the sample and (b) the laboratory.

Frequency: (a) non-isotope dilution analyses: every 10th sample (10% QA); (b) isotope dilution analyses: every sample (100% QA).

(2) Periodic spikes into a reference matrix

Implemented by: adding a known amount(s) of the analyte(s) of interest to a sample with known characteristics. Reagent water (water in which the analytes of interest or interfering compounds are not present) is usually used as the reference matrix.

Quantities measured: recovery and precision.

Purposes: (1) to assess laboratory performance, (2) to permit generation of statements of data quality for the laboratory, and (3) to permit separation of error sources between (a) the sample and (b) the laboratory.

Frequency: every sample set (samples started through the analytical process at the same time.)

(3) Analysis of blanks

Implemented by: analyzing reagent water or other material which does not contain the analytes of interest or interfering compounds.

Quantity measured: analytes of interest; test is failed or data must be qualified if any are detected.

Purpose: to assure that the analysis system is free from interferences so that analytes detected are known to originate in samples only.

Frequency: every sample set.

(4) Verification of instrument calibration

Implemented by: injecting a standard containing the analyte(s) of interest.

Quantity measured: calibration factor (usually response as unit height or area relative to amount or concentration injected); response factor (height or area relative to amount or concentration injected and relative to an internal standard); relative response for isotope dilution (height or area relative to amount or concentration injected and relative to a stable isotopically labeled analogue of the compound of interest). (The methods in Appendix D describe how calibration is verified for each analytical system used.)

Purpose: to assure that the instrument remains in calibration.

Frequency: every 24 hours minimum; most tests, every 12 hours; isotope dilution, every 8 hours.

(5) Dilution of a sample when the concentration of analyte exceeds the analytical range of the analysis system

Implemented by: requiring dilution each time an analyte exceeds the analytical range.

Quantity measured: concentration or amount.

Purpose: to assure that the concentration of every analyte will be measured accurately.

Frequency: every occurrence.

(6) In isotope dilution analyses, dilution of a sample when the recovery of a labeled compound is not in the range considered normal for the analysis

Implemented by: requiring dilution each occurrence.

Quantity measured: labeled compound recovery.

Purpose: to assure that the method works on the sample.

Frequency: every occurrence.

Data Reporting

The reporting of analytical data was quality assured by the crosschecking of sample numbers across all data collection and reporting activities. Data were required to be present for every fraction that was analyzed of every sample. As data were received, the tracking file at the Sample Control Center was updated with data status. For late or missing data, the Center telephoned the laboratories to determine when the data would be provided. The data quality objective for completeness greater than 95 percent was met.

Non-compliances and Corrective Actions

For organic analytes tested using isotope dilution methods, non-compliances occurred in less than 2 percent of the analyses performed. Non-compliances for these analyses are on record in the data base in the NCC IBM mainframe. These non-compliances were instances in which the labeled compound recovery or recovery of a standard did not fall within the range specified in the method. In nearly every instance, the non-compliant data were associated with a pollutant which was not detected in the affected sample, and the non-compliances were deemed of no adverse consequence.

Duplicates. As a check on sampling and laboratory reproducibility, duplicate samples were collected at several sites. In reviewing the Traffic Reports for these samples, the QA Officer at the Sample Control Center discovered that the samples had been marked as duplicates and, therefore, were not blind to the laboratory. As a result, tests were eliminated for the initial sets of duplicate samples. The marking of duplicates was eliminated as a corrective action, and duplicates collected in later stages of sampling were analyzed blind, as intended.

Holding Times. Laboratory tests exceeded the requirement that the pH of the sample be taken immediately; therefore, results for pH should be used as an indicator only. Similarly, holding times for oil and grease tests were exceeded for a number of samples and the data should be similarly qualified. For the samples received from Alaska, holding times were exceeded in all cases where holding times are less than 7 days because of delays in sample shipping. The data for the Alaska sites were included in the data base because the exceeding of holding times was unavoidable and Project Management believes that data from samples for which holding times were exceeded are better than no data at all. For all other cases in which a holding time was exceeded (estimated to be less than 1 percent of the total number of samples), the results were not used.

Contamination of Blanks. For organic analyses, field blanks were found to be contaminated with methylene chloride and acetone. The source of contamination was traced to bottle cleaning and sampling procedures. For semi-volatile organic samples, bottles were rinsed with methylene chloride and/or acetone prior to shipment to the site. In some instances, grab samples were collected and/or composited in these bottles, and samples were then transferred to bottles used for analysis of volatiles. This process was not discovered until late in the

Project. The results for acetone and methylene chloride should therefore be considered invalid.

Performance and System Audits

The laboratory analysis and statistical analysis were audited by the Project QA Officer and/or the Sample Control Center during the time samples were being collected and analyzed, and the data were being analyzed. A summary of the audits performed is given in Table 14.

Table 14. Summary of Performance and System Audits

Sampling and Laboratory Audits by Project Personnel

Laboratory	Date	By	Documentation
S-CUBED	7/86	Telliard	ITD
CENTEC Analytical Services	5/86	Telliard	ITD

Laboratory Audits in Support of Superfund and OSW Activities

Laboratory	Date	By	Documentation
S-CUBED	3/86	Richardson	OSW
	4/86	Bottrell	Superfund CLP
CENTEC Analytical Services	5/86	White	Superfund CLP

Laboratory Performance Evaluations

Laboratory	Date	Organization	Documentation
S-CUBED	2/86	OSW	OSW
	3/86	CA DOHS	CA DOHS
	5/86	Superfund CLP	EMSL-LV
	5/86	OSW	OSW
	6/86	Superfund CLP	EMSL-LV
	6/86	OSW	OSW
	8/86	Superfund CLP	EMSL-LV
	9/86	State of VA	State of VA
	10/86	Superfund CLP	EMSL-LV
CENTEC Analytical Services	2/86	OSW	EMSL-LV
		Superfund CLP	EMSL-LV
	5/86	OSW	EMSL-LV
		Superfund CLP	EMSL-LV
	8/86	OSW	EMSL-LV
		Superfund CLP	EMSL-LV
	10/86	OSW	EMSL-LV
		Superfund CLP	EMSL-LV

RESULTS AND CONCLUSIONS

This section gives data summaries in the form of tables. Appendix A gives a complete data listing for the Project. The data in Appendix A are ordered by decreasing concentration for each analyte within a given sample point location (e.g., pit, centralized treatment effluent), sample phase (liquid or solid), and extraction method (direct or TCLP).

Statistical Analysis

Summary statistics were computed for each sampling category, including number of samples analyzed, number with each compound detected, and the minimum, mean, and maximum concentrations of the analyte for the sampling category. Table 15 shows these values for each category (Central Pit; Central Treatment), Location within the Site (the Pit; Influent; Effluent; Tank), the Sample Phase (Liquid; Solid), and the Sample Extraction Technique (Direct; TCLP). These results are given as "Site/Location/Phase/Extract" data because each of these variables has been treated separately.

Calculation of Volume-Weighted Mean Concentration Estimates

In order to produce estimated national mean concentration estimates which are compatible with estimated waste volume figures and that could be appropriately multiplied by waste volumes to obtain pollutant loadings, the mean concentrations reported are weighted by the appropriate waste

Table 15

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------- Site=Central Pit , Location=Central Pit , Phase=Liquid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	4	4	1.000	0.3	0.6	0.8	mg/L
1-002	Biochemical Oxygen Demand	4	4	1.000	11.0	385.2	630.0	mg/L
1-003	Chloride	4	4	1.000	1620.0	11530.0	31000.0	mg/L
1-004	Chemical Oxygen Demand	4	4	1.000	2280.0	7257.5	19500.0	mg/L
1-005	Nitrate/nitrite	4	4	1.000	1.1	4.3	6.8	mg/L
1-006	Hydrogen ion	4	4	1.000	5.7	7.5	8.5	pH
1-007	Oil and grease	4	4	1.000	8.0	37.2	111.0	mg/L
1-009	Residue, non-filterable	4	4	1.000	192.0	4246.0	16000.0	mg/L
1-010	Residue, filterable	4	4	1.000	2600.0	17150.0	26000.0	mg/L
1-011	Specific conductivity	4	4	1.000	8000.0	42750.0	80000.0	umho/cm
1-012	Total organic carbon	4	4	1.000	27.0	481.5	996.0	mg/L
1-013	Ignitability	4	4	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	4	4	1.000	5.7	7.5	8.5	pH
65850	Benzoic acid	4	2	0.500	<DL	623.8	2390.2	ug/L
67641	2-Propanone	4	3	0.750	<DL	2381.5	5624.2	ug/L
71432	Benzene	4	2	0.500	<DL	73.1	216.7	ug/L
75092	Methylene chloride	4	4	1.000	108.2	261848.0	1011774.9	ug/L
75150	Carbon disulfide	4	1	0.250	<DL	3.4	13.6	ug/L
78933	2-Butanone	4	1	0.250	<DL	12.5	50.1	ug/L
84742	Di-n-butyl phthalate	4	1	0.250	<DL	390.4	1561.8	ug/L
85018	Phenanthrene	4	2	0.500	<DL	24.7	74.7	ug/L
86737	Fluorene	4	2	0.500	<DL	9.4	26.9	ug/L
91203	Naphthalene	4	3	0.750	<DL	38.5	94.2	ug/L
91576	2-Methylnaphthalene	4	3	0.750	<DL	68.6	128.5	ug/L
92524	Biphenyl	4	2	0.500	<DL	11.7	26.1	ug/L
95487	o-Cresol	4	2	0.500	<DL	23.2	69.7	ug/L
98862	Acetophenone	4	1	0.250	<DL	3.7	15.1	ug/L
99876	p-Cymene	4	3	0.750	<DL	9.3	13.6	ug/L
100414	Ethylbenzene	4	1	0.250	<DL	5.2	21.0	ug/L
100516	Benzyl alcohol	4	1	0.250	<DL	85.3	341.2	ug/L
105679	2,4-Dimethylphenol	4	1	0.250	<DL	11.2	44.9	ug/L
106445	p-Cresol	4	2	0.500	<DL	125.5	364.9	ug/L
108101	4-Methyl-2-pentanone	4	2	0.500	<DL	11.4	25.8	ug/L
108883	Toluene	4	2	0.500	<DL	5339.1	21159.9	ug/L
108952	Phenol	4	1	0.250	<DL	292.8	1171.3	ug/L
112403	n-Dodecane	4	4	1.000	38.6	815.1	1547.7	ug/L
112958	n-Eicosane	4	4	1.000	22.7	740.8	2421.3	ug/L
117817	bis(2-Ethylhexyl) phthalate	4	2	0.500	<DL	577.6	2231.0	ug/L
124185	n-Decane	4	3	0.750	<DL	416.7	832.8	ug/L
129000	Pyrene	4	1	0.250	<DL	2.8	11.5	ug/L
132649	Dibenzofuran	4	1	0.250	<DL	3.4	13.7	ug/L
132650	Dibenzothiophene	4	2	0.500	<DL	7.4	19.1	ug/L
142621	hexanoic acid	4	1	0.250	<DL	141.7	566.9	ug/L
544763	n-Hexadecane	4	4	1.000	37.3	1297.2	3859.8	ug/L
593453	n-Octadecane	4	4	1.000	20.8	1014.1	3575.3	ug/L
629594	n-Tetradecane	4	4	1.000	31.3	711.2	2405.4	ug/L
629970	n-Docosane	4	4	1.000	17.8	444.1	1472.7	ug/L
630013	n-Hexacosane	4	4	1.000	15.5	90.6	179.6	ug/L
630024	n-Octacosane	4	3	0.750	<DL	47.0	113.6	ug/L
638686	n-Triacontane	4	2	0.500	<DL	64.0	236.0	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of Crude Oil and Natural Gas

(Compounds detected in one or more samples only)

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Liquid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
646311	n-Tetracosane	4	4	1.000	17.6	125.6	220.5	ug/L
832699	1-Methylphenanthrene	4	1	0.250	<DL	17.2	69.1	ug/L
1730376	1-Methylfluorene	4	1	0.250	<DL	2.9	11.8	ug/L
7429905	Aluminum	4	4	1.000	822.0	78310.5	289000.0	ug/L
7439896	Iron	4	4	1.000	4120.0	296100.0	1130000.0	ug/L
7439921	Lead	4	2	0.500	<DL	721.2	2460.0	ug/L
7439932	Lithium	4	3	0.750	<DL	2728.7	5730.0	ug/L
7439954	Magnesium	4	4	1.000	59600.0	280975.0	842000.0	ug/L
7439965	Manganese	4	4	1.000	127.0	4186.7	12400.0	ug/L
7439987	Molybdenum	4	2	0.500	<DL	123.2	292.0	ug/L
7440020	Nickel	4	3	0.750	<DL	331.7	1220.0	ug/L
7440097	Potassium	4	3	0.750	<DL	1385000.0	4010000.0	ug/L
7440213	Silicon	4	4	1.000	19800.0	42400.0	99800.0	ug/L
7440224	Silver	4	2	0.500	<DL	0.8	2.2	ug/L
7440235	Sodium	4	4	1.000	604000.0	7413500.0	15200000.0	ug/L
7440246	Strontium	4	4	1.000	6590.0	39397.5	58400.0	ug/L
7440315	Tin	4	4	1.000	117.0	422.2	756.0	ug/L
7440326	Titanium	4	3	0.750	<DL	213.2	390.0	ug/L
7440382	Arsenic	4	2	0.500	<DL	690.7	2720.0	ug/L
7440393	Barium	4	4	1.000	1060.0	3297.5	7660.0	ug/L
7440417	Beryllium	4	1	0.250	<DL	11.7	47.0	ug/L
7440428	Boron	4	4	1.000	3020.0	15532.5	39700.0	ug/L
7440439	Cadmium	4	2	0.500	<DL	49.2	184.0	ug/L
7440451	Cerium	4	2	0.500	<DL	192.2	537.0	ug/L
7440473	Chromium	4	2	0.500	<DL	998.0	3490.0	ug/L
7440484	Cobalt	4	1	0.250	<DL	124.5	498.0	ug/L
7440508	Copper	4	2	0.500	<DL	188.2	610.0	ug/L
7440622	Vanadium	4	2	0.500	<DL	308.5	944.0	ug/L
7440655	Yttrium	4	1	0.250	<DL	94.5	378.0	ug/L
7440666	Zinc	4	4	1.000	50.0	2232.7	4720.0	ug/L
7440702	Calcium	4	4	1.000	109000.0	1125750.0	3340000.0	ug/L
7664417	Ammonia	4	4	1.000	1.0	6.6	12.0	mg/L
7704349	Sulfur	4	4	1.000	13800.0	161700.0	362000.0	ug/L
7723140	Phosphorus (black, white, red, yell	4	2	0.500	<DL	2271.2	8200.0	ug/L
16984488	Fluoride	4	4	1.000	1.7	2.1	3.2	mg/L

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	3	3	1.000	17.0	87.3	220.0	mg/kg
1-002	Biochemical Oxygen Demand	3	3	1.000	44.0	4308.0	10400.0	mg/kg
1-003	Chloride	3	3	1.000	5140.0	34013.3	77500.0	mg/kg
1-004	Chemical Oxygen Demand	3	3	1.000	6150.0	30250.0	71500.0	mg/kg
1-005	Nitrate/nitrite	3	3	1.000	3.1	20.7	30.0	mg/kg
1-006	Hydrogen ion	3	3	1.000	7.2	8.0	9.2	pH
1-007	Oil and grease	3	3	1.000	3750.0	34683.3	81300.0	mg/kg
1-008	Residue, total	3	3	1.000	14.4	44.6	67.4	%
1-012	Total organic carbon	3	3	1.000	10500.0	24366.6	49000.0	mg/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-013	Ignitability	3	3	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	3	3	1.000	7.2	8.0	9.2	pH
1-015	Reactivity	3	2	0.667	<DL	0.6	1.0	S(-/+)
1-016	Oil and Grease (Retort)	3	3	1.000	10800.0	42500.0	67900.0	mg/kg
1_331	Tetrachlorodibenzo-p-dioxins	2	1	0.500	<DL	4.2	8.5	ng/kg
67641	2-Propanone	3	3	1.000	353.6	2771.4	7218.3	ug/kg
75092	Methylene chloride	3	1	0.333	<DL	5190.5	15571.7	ug/kg
78933	2-Butanone	3	1	0.333	<DL	42.0	126.2	ug/kg
84742	Di-n-butyl phthalate	3	1	0.333	<DL	72.9	218.7	ug/kg
85018	Phenanthrene	3	1	0.333	<DL	163.7	491.3	ug/kg
91203	Naphthalene	3	1	0.333	<DL	7856.8	23570.5	ug/kg
91576	2-Methylnaphthalene	3	1	0.333	<DL	10645.2	31935.8	ug/kg
92524	Biphenyl	3	2	0.667	<DL	63.4	168.9	ug/kg
99876	p-Cymene	3	1	0.333	<DL	5868.2	17604.7	ug/kg
100414	Ethylbenzene	3	1	0.333	<DL	3700.9	11102.9	ug/kg
106445	p-Cresol	3	2	0.667	<DL	6486.3	19089.1	ug/kg
108101	4-Methyl-2-pentanone	3	1	0.333	<DL	6.1	18.3	ug/kg
108883	Toluene	3	2	0.667	<DL	17.6	30.4	ug/kg
112403	n-Dodecane	3	1	0.333	<DL	28755.7	86267.3	ug/kg
112958	n-Eicosane	3	3	1.000	5332.5	148156.8	425362.9	ug/kg
117817	bis(2-Ethylhexyl) phthalate	3	3	1.000	6788.4	83810.1	236351.1	ug/kg
124185	n-Decane	3	2	0.667	<DL	8870.8	22131.1	ug/kg
127184	Tetrachlorethene	3	3	1.000	2417.2	102979.7	291914.1	ug/kg
544763	n-Hexadecane	3	1	0.333	<DL	6.3	18.9	ug/kg
593453	n-Octadecane	3	3	1.000	12313.3	152957.1	431419.4	ug/kg
629594	n-Tetradecane	3	3	1.000	3761.4	148494.2	430702.9	ug/kg
629970	n-Docosane	3	3	1.000	3351.4	166648.5	486199.4	ug/kg
630013	n-Hexacosane	3	3	1.000	2430.9	66645.0	194617.6	ug/kg
630024	n-Octacosane	3	3	1.000	1258.3	34872.2	101505.8	ug/kg
638585	n-Triacontane	3	2	0.667	<DL	18029.4	53604.1	ug/kg
646311	n-Tetracosane	3	2	0.667	<DL	15064.7	43514.1	ug/kg
832699	1-Methylphenanthrene	3	3	1.000	1423.8	36785.3	104378.8	ug/kg
1730376	1-Methylfluorene	3	2	0.667	<DL	21.4	53.2	ug/kg
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	3	1	0.333	<DL	3.5	10.7	ug/kg
3268879	Octachlorodibenzo-p-dioxins	2	1	0.500	<DL	9.8	19.7	ng/kg
7429905	Aluminum	2	2	1.000	23.5	198.9	374.3	ng/kg
7439896	Iron	3	3	1.000	4280.0	14726.6	21800.0	mg/kg
7439921	Lead	3	3	1.000	11900.0	24033.3	36900.0	mg/kg
7439954	Magnesium	3	3	1.000	15.0	131.3	233.0	mg/kg
7439965	Manganese	3	3	1.000	5730.0	8293.3	12400.0	mg/kg
7439987	Molybdenum	3	3	1.000	157.0	394.6	666.0	mg/kg
7440020	Nickel	3	1	0.333	<DL	5.3	16.0	mg/kg
7440097	Potassium	3	2	0.667	<DL	18.6	49.0	mg/kg
7440213	Silicon	3	1	0.333	<DL	3600.0	10800.0	mg/kg
7440224	Silver	3	2	0.667	<DL	982.0	2340.0	mg/kg
7440235	Sodium	3	1	0.333	<DL	0.0	0.2	mg/kg
7440246	Strontium	3	3	1.000	2990.0	21196.6	46200.0	mg/kg
7440315	Tin	3	2	0.667	<DL	97.6	162.0	mg/kg
7440326	Titanium	3	2	0.667	<DL	17.3	37.0	mg/kg
		3	3	1.000	80.0	190.0	316.0	mg/kg

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
7440382	Arsenic	3	1	0.333	<DL	3.6	11.0	mg/kg
7440393	Barium	3	3	1.000	150.0	4643.3	8710.0	mg/kg
7440428	Boron	3	2	0.667	<DL	72.3	110.0	mg/kg
7440439	Cadmium	3	2	0.667	<DL	3.3	7.0	mg/kg
7440473	Chromium	3	3	1.000	21.0	63.0	139.0	mg/kg
7440508	Copper	3	3	1.000	13.0	27.0	40.0	mg/kg
7440622	Vanadium	3	3	1.000	38.0	57.3	85.0	mg/kg
7440655	Yttrium	3	1	0.333	<DL	4.3	13.0	mg/kg
7440666	Zinc	3	3	1.000	71.0	171.0	255.0	mg/kg
7440702	Calcium	3	3	1.000	34900.0	38800.0	45500.0	mg/kg
7664417	Ammonia	3	2	0.667	<DL	9.3	27.0	mg/kg
7704349	Sulfur	3	3	1.000	1380.0	4156.6	7480.0	mg/kg
7723140	Phosphorus (black, white, red, yell	3	2	0.667	<DL	512.0	910.0	mg/kg
16984488	Fluoride	3	3	1.000	190.0	516.6	690.0	mg/kg
18496258	Sulfide	3	2	0.667	<DL	1760.0	4790.0	mg/kg

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	3	2	0.667	<DL	77.3	159.5	ug/L
71432	Benzene	3	2	0.667	<DL	81.4	229.5	ug/L
75092	Methylene chloride	3	2	0.667	<DL	50.5	140.1	ug/L
75150	Carbon disulfide	3	1	0.333	<DL	17.5	52.6	ug/L
79005	1,1,2-Trichloroethane	3	1	0.333	<DL	23.8	71.5	ug/L
91203	Naphthalene	3	1	0.333	<DL	43.1	129.5	ug/L
91576	2-Methylnaphthalene	3	3	1.000	10.3	49.1	116.0	ug/L
92524	Biphenyl	3	1	0.333	<DL	6.8	20.4	ug/L
100414	Ethylbenzene	3	2	0.667	<DL	42.4	99.8	ug/L
107062	1,2-Dichloroethane	3	1	0.333	<DL	32.3	96.9	ug/L
108101	4-Methyl-2-pentanone	3	2	0.667	<DL	31.9	58.8	ug/L
108883	Toluene	3	2	0.667	<DL	495.3	1331.4	ug/L
108952	Phenol	3	1	0.333	<DL	5.1	15.4	ug/L
112403	n-Dodecane	3	1	0.333	<DL	9.2	27.8	ug/L
112958	n-Eicosane	3	1	0.333	<DL	9.5	28.5	ug/L
117817	bis(2-Ethylhexyl) phthalate	3	1	0.333	<DL	40.4	121.2	ug/L
544763	n-Hexadecane	3	1	0.333	<DL	15.4	46.2	ug/L
593453	n-Octadecane	3	1	0.333	<DL	9.5	28.5	ug/L
629594	n-Tetradecane	3	1	0.333	<DL	10.6	31.9	ug/L
629970	n-Docosane	3	1	0.333	<DL	4.2	12.7	ug/L
7429905	Aluminum	3	3	1.000	476.0	4008.6	9310.0	ug/L
7439896	Iron	3	3	1.000	24700.0	42066.6	64800.0	ug/L
7439921	Lead	3	1	0.333	<DL	71.0	213.0	ug/L
7439954	Magnesium	3	3	1.000	25400.0	37166.6	45800.0	ug/L
7439965	Manganese	3	3	1.000	3000.0	3976.6	4940.0	ug/L
7439987	Molybdenum	3	2	0.667	<DL	76.6	118.0	ug/L
7440020	Nickel	3	1	0.333	<DL	16.0	48.0	ug/L
7440097	Potassium	3	1	0.333	<DL	72666.6	218000.0	ug/L
7440213	Silicon	3	2	0.667	<DL	5423.3	9380.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Central Pit , Location=Central Pit , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
7440235	Sodium	3	3	1.000	119000.0	896333.3	2380000.0	ug/L
7440246	Strontium	3	2	0.667	<DL	2050.0	3610.0	ug/L
7440315	Tin	3	3	1.000	181.0	317.3	444.0	ug/L
7440326	Titanium	3	1	0.333	<DL	43.3	130.0	ug/L
7440382	Arsenic	3	1	0.333	<DL	8.0	24.0	ug/L
7440393	Barium	3	3	1.000	1980.0	3603.3	4580.0	ug/L
7440428	Boron	3	3	1.000	211.0	1060.3	1530.0	ug/L
7440473	Chromium	3	1	0.333	<DL	63.0	189.0	ug/L
7440508	Copper	3	1	0.333	<DL	11.3	34.0	ug/L
7440622	Vanadium	3	1	0.333	<DL	57.3	172.0	ug/L
7440666	Zinc	3	3	1.000	73.0	963.0	2080.0	ug/L
7440702	Calcium	3	3	1.000	445000.0	719666.6	999000.0	ug/L
7704349	Sulfur	3	3	1.000	2580.0	10603.3	24800.0	ug/L
7723140	Phosphorus (black, white, red, yell	3	2	0.667	<DL	246.6	532.0	ug/L

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Liquid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	3	2	0.667	<DL	4.2	10.0	mg/L
1-002	Biochemical Oxygen Demand	3	3	1.000	31.0	3457.0	9750.0	mg/L
1-003	Chloride	3	3	1.000	950.0	3376.6	8100.0	mg/L
1-004	Chemical Oxygen Demand	3	3	1.000	280.0	826.6	1200.0	mg/L
1-005	Nitrate/nitrite	3	1	0.333	<DL	20.0	60.0	mg/L
1-006	Hydrogen ion	3	3	1.000	7.0	8.2	10.1	pH
1-007	Oil and grease	3	3	1.000	14.0	17.0	22.0	mg/L
1-009	Residue, non-filterable	3	3	1.000	23.0	169.0	284.0	mg/L
1-010	Residue, filterable	3	3	1.000	2780.0	37793.3	79000.0	mg/L
1-011	Specific conductivity	3	3	1.000	4800.0	588266.6	1700000.0	umho/cm
1-012	Total organic carbon	3	3	1.000	80.0	193.3	280.0	mg/L
1-013	Ignitability	3	3	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	3	3	1.000	7.0	8.2	10.1	pH
1-015	Reactivity	3	1	0.333	<DL	0.3	1.0	S(-/+)
65850	Benzoic acid	3	1	0.333	<DL	1878.6	5636.0	ug/L
67641	2-Propanone	3	3	1.000	100.5	1592.0	3438.7	ug/L
67663	Chloroform	3	1	0.333	<DL	6.2	18.8	ug/L
71432	Benzene	3	2	0.667	<DL	926.4	2497.2	ug/L
71556	1,1,1-Trichloroethane	3	1	0.333	<DL	5.9	17.8	ug/L
75092	Methylene chloride	3	2	0.667	<DL	98.1	276.7	ug/L
75274	Bromodichloromethane	3	1	0.333	<DL	5.0	15.2	ug/L
78933	2-Butanone	3	3	1.000	82.1	136.5	184.7	ug/L
79005	1,1,2-Trichloroethane	3	1	0.333	<DL	4.8	14.6	ug/L
91203	Naphthalene	3	1	0.333	<DL	57.6	173.0	ug/L
95487	o-Cresol	3	2	0.667	<DL	82.2	217.9	ug/L
95534	o-Toluidine	3	1	0.333	<DL	5.0	15.0	ug/L
100414	Ethylbenzene	3	1	0.333	<DL	45.0	135.2	ug/L
105679	2,4-Dimethylphenol	3	2	0.667	<DL	132.5	360.1	ug/L
106445	p-Cresol	3	3	1.000	19.0	122.1	326.7	ug/L
108101	4-Methyl-2-pentanone	3	1	0.333	<DL	22.9	68.8	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas

(Compounds detected in one or more samples only)

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Liquid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
108883	Toluene	3	2	0.667	<DL	426.6	1206.1	ug/L
108907	Chlorobenzene	3	1	0.333	<DL	6.8	20.5	ug/L
108952	Phenol	3	3	1.000	23.0	1172.0	3197.1	ug/L
112403	n-Dodecane	3	2	0.667	<DL	81.1	126.1	ug/L
112958	n-Eicosane	3	1	0.333	<DL	15.0	45.0	ug/L
117817	bis(2-Ethylhexyl) phthalate	3	2	0.667	<DL	41.7	104.7	ug/L
124185	n-Decane	3	2	0.667	<DL	35.8	77.2	ug/L
142621	hexanoic acid	3	1	0.333	<DL	175.3	525.9	ug/L
544763	n-Hexadecane	3	2	0.667	<DL	44.3	84.1	ug/L
593453	n-Octadecane	3	2	0.667	<DL	48.7	94.4	ug/L
629594	n-Tetradecane	3	2	0.667	<DL	66.2	105.1	ug/L
638686	n-Triacontane	3	2	0.667	<DL	14.4	24.1	ug/L
646311	n-Tetracosane	3	2	0.667	<DL	14.3	26.2	ug/L
7439896	Iron	3	2	0.667	<DL	183.6	390.0	ug/L
7439932	Lithium	3	2	0.667	<DL	2854.6	7740.0	ug/L
7439954	Magnesium	3	3	1.000	7050.0	90016.6	138000.0	ug/L
7439965	Manganese	3	2	0.667	<DL	662.6	1290.0	ug/L
7439987	Molybdenum	3	2	0.667	<DL	103.0	176.0	ug/L
7440097	Potassium	3	2	0.667	<DL	110666.6	222000.0	ug/L
7440213	Silicon	3	2	0.667	<DL	2013.3	3810.0	ug/L
7440224	Silver	3	1	0.333	<DL	0.5	1.7	ug/L
7440235	Sodium	3	3	1.000	727000.0	8485666.6	21200000.0	ug/L
7440246	Strontium	3	3	1.000	3480.0	70826.6	129000.0	ug/L
7440315	Tin	3	2	0.667	<DL	589.6	1040.0	ug/L
7440360	Antimony	3	1	0.333	<DL	25.3	76.0	ug/L
7440393	Barium	3	3	1.000	230.0	6556.6	15100.0	ug/L
7440428	Boron	3	3	1.000	1030.0	3676.6	8850.0	ug/L
7440473	Chromium	3	3	1.000	50.0	66.3	80.0	ug/L
7440622	Vanadium	3	1	0.333	<DL	24.6	74.0	ug/L
7440666	Zinc	3	3	1.000	42.0	190.0	472.0	ug/L
7440702	Calcium	3	3	1.000	248000.0	3599333.3	7010000.0	ug/L
7664417	Ammonia	3	3	1.000	2.1	35.5	100.0	mg/L
7704349	Sulfur	3	3	1.000	65500.0	154500.0	297000.0	ug/L
7723140	Phosphorus (black, white, red, yell	3	1	0.333	<DL	680.0	2040.0	ug/L
16984488	Fluoride	3	3	1.000	0.6	1.6	3.6	mg/L

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Solid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	3	3	1.000	2.6	125.8	370.0	mg/kg
1-002	Biochemical Oxygen Demand	3	3	1.000	27.0	3452.3	6270.0	mg/kg
1-003	Chloride	3	3	1.000	2030.0	324890.0	967000.0	mg/kg
1-004	Chemical Oxygen Demand	3	3	1.000	7810.0	55936.6	150000.0	mg/kg
1-005	Nitrate/nitrite	3	1	0.333	<DL	27.3	82.0	mg/kg
1-006	Hydrogen ion	3	3	1.000	6.7	8.2	10.0	pH
1-007	Oil and grease	3	3	1.000	5050.0	20083.3	42400.0	mg/kg
1-008	Residue, total	3	3	1.000	30.3	50.1	68.9	%
1-012	Total organic carbon	3	3	1.000	36700.0	68200.0	97900.0	mg/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Solid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-013	Ignitability	3	3	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	3	3	1.000	6.7	8.2	10.0	pH
1-015	Reactivity	3	1	0.333	<DL	0.3	1.0	S(-/+)
1-016	Oil and Grease (Retort)	3	3	1.000	3910.0	15603.3	27100.0	mg/kg
1_331	Tetrachlorodibenzo-p-dioxins	4	1	0.333	<DL	2.5	7.7	ng/kg
67641	2-Propanone	3	1	0.333	<DL	25.7	77.3	ug/kg
71432	Benzene	3	1	0.333	<DL	974.5	2923.6	ug/kg
75092	Methylene chloride	3	1	0.333	<DL	8.3	25.1	ug/kg
84742	Di-n-butyl phthalate	3	1	0.333	<DL	313.6	940.8	ug/kg
85018	Phenanthrene	3	1	0.333	<DL	4.8	14.4	ug/kg
91203	Naphthalene	3	1	0.333	<DL	243.7	731.2	ug/kg
91576	2-Methylnaphthalene	3	1	0.333	<DL	8.3	25.1	ug/kg
92524	Biphenyl	3	1	0.333	<DL	2729.1	8187.5	ug/kg
99876	p-Cymene	3	1	0.333	<DL	13038.7	39116.2	ug/kg
100414	Ethylbenzene	3	1	0.333	<DL	5.8	17.5	ug/kg
100425	Styrene	3	1	0.333	<DL	2775.2	8325.7	ug/kg
108101	4-Methyl-2-pentanone	3	1	0.333	<DL	5.5	16.7	ug/kg
108883	Toluene	3	1	0.333	<DL	2936.4	8809.4	ug/kg
112403	n-Dodecane	3	2	0.667	<DL	263026.6	785243.7	ug/kg
112958	n-Eicosane	3	2	0.667	<DL	7148.1	18646.2	ug/kg
117817	bis(2-Ethylhexyl) phthalate	3	1	0.333	<DL	1668.3	5005.1	ug/kg
124185	n-Decane	3	2	0.667	<DL	167730.8	503050.6	ug/kg
132650	Dibenzothiophene	3	1	0.333	<DL	3.7	11.3	ug/kg
544763	n-Hexadecane	3	2	0.667	<DL	23878.0	60351.2	ug/kg
593453	n-Octadecane	3	3	1.000	763.3	132105.7	386676.2	ug/kg
629594	n-Tetradecane	3	2	0.667	<DL	177661.5	532883.1	ug/kg
629970	n-Docosane	3	2	0.667	<DL	130628.8	391725.0	ug/kg
630013	n-Hexacosane	3	3	1.000	842.9	122851.5	319366.8	ug/kg
630024	n-Octacosane	3	2	0.667	<DL	107472.9	321328.7	ug/kg
638686	n-Triacontane	3	1	0.333	<DL	2864.7	8594.1	ug/kg
646311	n-Tetracosane	3	2	0.667	<DL	40090.2	116414.3	ug/kg
832699	1-Methylphenanthrene	3	1	0.333	<DL	13.9	41.8	ug/kg
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	4	1	0.333	<DL	3.3	10.1	ng/kg
3268879	Octachlorodibenzo-p-dioxins	4	1	0.333	<DL	9.6	29.0	ng/kg
7429905	Aluminum	3	3	1.000	3820.0	8080.0	16000.0	mg/kg
7439896	Iron	3	3	1.000	6990.0	16430.0	25100.0	mg/kg
7439921	Lead	3	2	0.667	<DL	72.3	182.0	mg/kg
7439954	Magnesium	3	3	1.000	1450.0	68173.3	197000.0	mg/kg
7439965	Manganese	3	3	1.000	254.0	605.3	1070.0	mg/kg
7440020	Nickel	3	3	1.000	6.0	15.0	26.0	mg/kg
7440213	Silicon	3	3	1.000	674.0	964.6	1380.0	mg/kg
7440224	Silver	3	1	0.333	<DL	0.4	1.4	mg/kg
7440235	Sodium	3	3	1.000	1230.0	8690.0	18700.0	mg/kg
7440246	Strontium	3	3	1.000	448.0	656.3	845.0	mg/kg
7440315	Tin	3	3	1.000	29.0	36.0	43.0	mg/kg
7440326	Titanium	3	3	1.000	50.0	210.3	406.0	mg/kg
7440382	Arsenic	3	3	1.000	4.8	7.7	13.0	mg/kg
7440393	Barium	3	3	1.000	2080.0	11933.3	29700.0	mg/kg
7440428	Boron	3	2	0.667	<DL	96.6	252.0	mg/kg
7440439	Cadmium	3	2	0.667	<DL	1.6	3.0	mg/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Solid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
7440473	Chromium	3	2	0.667	<DL	147.3	426.0	mg/kg
7440508	Copper	3	2	0.667	<DL	32.0	53.0	mg/kg
7440622	Vanadium	3	2	0.667	<DL	14.3	26.0	mg/kg
7440666	Zinc	3	3	1.000	92.0	815.3	2251.0	mg/kg
7440702	Calcium	3	3	1.000	50500.0	56833.3	61000.0	mg/kg
7664417	Ammonia	3	3	1.000	0.2	48.7	76.0	mg/kg
7704349	Sulfur	3	2	0.667	<DL	1643.3	2860.0	mg/kg
7723140	Phosphorus (black, white, red, yell	3	2	0.667	<DL	487.6	1200.0	mg/kg
16984488	Fluoride	3	3	1.000	41.0	293.6	560.0	mg/kg
18496258	Sulfide	3	1	0.333	<DL	328.6	986.0	mg/kg

---------------------------- Site=Central Treatment , Location=Effluent , Phase=Solid , Extract=TCLP ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	3	2	0.667	<DL	75.0	138.6	ug/L
71432	Benzene	3	1	0.333	<DL	34.0	102.0	ug/L
71556	1,1,1-Trichloroethane	3	1	0.333	<DL	4.5	13.7	ug/L
75092	Methylene chloride	3	3	1.000	13.4	25.6	45.0	ug/L
75150	Carbon disulfide	3	1	0.333	<DL	103.5	310.6	ug/L
91203	Naphthalene	3	1	0.333	<DL	8.7	26.2	ug/L
91576	2-Methylnaphthalene	3	2	0.667	<DL	12.6	23.8	ug/L
99876	p-Cymene	3	1	0.333	<DL	5.0	15.2	ug/L
100414	Ethylbenzene	3	1	0.333	<DL	4.2	12.6	ug/L
108101	4-Methyl-2-pentanone	3	1	0.333	<DL	7.7	23.3	ug/L
108883	Toluene	3	1	0.333	<DL	109.8	329.4	ug/L
117817	bis(2-Ethylhexyl) phthalate	3	2	0.667	<DL	52.8	133.0	ug/L
7439896	Iron	3	1	0.333	<DL	616.6	1850.0	ug/L
7439954	Magnesium	3	3	1.000	2710.0	387936.6	1150000.0	ug/L
7439965	Manganese	3	2	0.667	<DL	1753.3	2760.0	ug/L
7440213	Silicon	3	3	1.000	307.0	1879.0	3300.0	ug/L
7440235	Sodium	3	3	1.000	551000.0	1080333.3	1360000.0	ug/L
7440246	Strontium	3	3	1.000	3890.0	4910.0	6190.0	ug/L
7440315	Tin	3	1	0.333	<DL	92.0	276.0	ug/L
7440393	Barium	3	3	1.000	512.0	2454.0	3720.0	ug/L
7440428	Boron	3	2	0.667	<DL	765.3	1370.0	ug/L
7440666	Zinc	3	2	0.667	<DL	1136.6	2110.0	ug/L
7440702	Calcium	3	3	1.000	332000.0	661666.6	939000.0	ug/L
7704349	Sulfur	3	3	1.000	7950.0	20550.0	37100.0	ug/L
7723140	Phosphorus (black, white, red, yell	3	1	0.333	<DL	166.6	500.0	ug/L
7782492	Selenium	3	1	0.333	<DL	7.3	22.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------- Site=Central Treatment , Location=Influent , Phase=Liquid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	2	2	1.000	8.0	11.0	14.0	mg/L
1-002	Biochemical Oxygen Demand	2	1	0.500	<DL	280.0	560.0	mg/L
1-003	Chloride	2	2	1.000	6500.0	18000.0	29500.0	mg/L
1-004	Chemical Oxygen Demand	2	2	1.000	460.0	7030.0	13600.0	mg/L
1-005	Nitrate/nitrite	2	1	0.500	<DL	0.6	1.2	mg/L
1-006	Hydrogen ion	2	2	1.000	5.7	6.5	7.3	pH
1-007	Oil and grease	2	2	1.000	13.0	32.5	52.0	mg/L
1-009	Residue, non-filterable	2	2	1.000	230.0	463.0	696.0	mg/L
1-010	Residue, filterable	2	2	1.000	32000.0	56650.0	81300.0	mg/L
1-011	Specific conductivity	2	2	1.000	45000.0	107500.0	170000.0	umho/cm
1-012	Total organic carbon	2	2	1.000	280.0	310.0	340.0	mg/L
1-013	Ignitability	2	2	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	2	2	1.000	5.7	6.5	7.3	pH
67641	2-Propanone	2	2	1.000	640.2	2477.7	4315.3	ug/L
71432	Benzene	2	1	0.500	<DL	176.8	353.7	ug/L
71556	1,1,1-Trichloroethane	2	1	0.500	<DL	44.7	89.4	ug/L
75092	Methylene chloride	2	2	1.000	146.7	175.0	203.3	ug/L
75274	Bromodichloromethane	2	1	0.500	<DL	18.2	36.4	ug/L
78933	2-Butanone	2	2	1.000	118.3	196.5	274.7	ug/L
79016	Trichloroethene	2	1	0.500	<DL	133.1	266.2	ug/L
85018	Phenanthrene	2	1	0.500	<DL	5.2	10.5	ug/L
91203	Naphthalene	2	1	0.500	<DL	130.0	260.0	ug/L
91576	2-Methylnaphthalene	2	1	0.500	<DL	61.4	122.9	ug/L
95487	o-Cresol	2	2	1.000	14.7	100.7	186.6	ug/L
99876	p-Cymene	2	1	0.500	<DL	13.7	27.4	ug/L
105679	2,4-Dimethylphenol	2	2	1.000	25.1	221.1	417.1	ug/L
106445	p-Cresol	2	1	0.500	<DL	211.1	422.3	ug/L
108101	4-Methyl-2-pentanone	2	1	0.500	<DL	31.1	62.2	ug/L
108883	Toluene	2	2	1.000	51.9	63.5	75.2	ug/L
108907	Chlorobenzene	2	1	0.500	<DL	12.4	24.9	ug/L
108952	Phenol	2	2	1.000	24.3	852.5	1680.6	ug/L
112403	n-Dodecane	2	2	1.000	170.1	180.4	190.7	ug/L
112959	n-Eicosane	2	2	1.000	88.4	117.9	147.5	ug/L
124185	n-Decane	2	2	1.000	85.5	106.6	127.7	ug/L
142621	hexanoic acid	2	1	0.500	<DL	296.1	592.2	ug/L
544763	n-Hexadecane	2	2	1.000	124.4	132.1	139.8	ug/L
593453	n-Octadecane	2	1	0.500	<DL	31.9	63.9	ug/L
629594	n-Tetradecane	2	2	1.000	58.7	79.7	100.6	ug/L
630013	n-Hexacosane	2	2	1.000	35.7	40.3	44.9	ug/L
638686	n-Triacontane	2	1	0.500	<DL	12.8	25.7	ug/L
646311	n-Tetracosane	2	2	1.000	31.2	50.7	70.3	ug/L
832699	1-Methylphenanthrene	2	1	0.500	<DL	5.5	11.1	ug/L
7439896	Iron	2	2	1.000	881.0	18790.5	36700.0	ug/L
7439932	Lithium	2	2	1.000	914.0	4887.0	8860.0	ug/L
7439954	Magnesium	2	2	1.000	104000.0	607000.0	1110000.0	ug/L
7439965	Manganese	2	2	1.000	1480.0	2360.0	3240.0	ug/L
7439987	Molybdenum	2	2	1.000	124.0	148.0	172.0	ug/L
7440097	Potassium	2	2	1.000	105000.0	175000.0	245000.0	ug/L
7440213	Silicon	2	2	1.000	4600.0	12650.0	20700.0	ug/L
7440224	Silver	2	2	1.000	14.0	15.0	16.0	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------- Site=Central Treatment , Location=Influent , Phase=Liquid , Extract=Direct -------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
7440235	Sodium	2	2	1.000	3590000.0	14045000.0	24500000.0	ug/L
7440246	Strontium	2	2	1.000	81400.0	109700.0	138000.0	ug/L
7440315	Tin	2	2	1.000	836.0	1073.0	1310.0	ug/L
7440393	Barium	2	2	1.000	3880.0	6225.0	8570.0	ug/L
7440423	Boron	2	2	1.000	1250.0	7125.0	13000.0	ug/L
7440473	Chromium	2	2	1.000	86.0	89.5	93.0	ug/L
7440666	Zinc	2	1	0.500	<DL	66.0	132.0	ug/L
7440702	Calcium	2	2	1.000	2240000.0	4330000.0	6420000.0	ug/L
7664417	Ammonia	2	2	1.000	1.8	7.9	14.0	mg/L
7704349	Sulfur	2	2	1.000	69600.0	93300.0	117000.0	ug/L
7723140	Phosphorus (black, white, red, yell	2	2	1.000	249.0	1194.5	2140.0	ug/L
16984488	Fluoride	2	2	1.000	0.6	2.2	3.8	mg/L

------------------------- Site=Central Treatment , Location=Influent , Phase=Solid , Extract=Direct -------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	1	1	1.000	10.0	10.0	10.0	mg/kg
1-002	Biochemical Oxygen Demand	1	1	1.000	3950.0	3950.0	3950.0	mg/kg
1-003	Chloride	1	1	1.000	526.0	526.0	526.0	mg/kg
1-004	Chemical Oxygen Demand	1	1	1.000	91000.0	91000.0	91000.0	mg/kg
1-005	Nitrate/nitrite	1	1	1.000	526.0	526.0	526.0	mg/kg
1-006	Hydrogen ion	1	1	1.000	8.8	8.8	8.8	pH
1-007	Oil and grease	1	1	1.000	8530.0	8530.0	8530.0	mg/kg
1-008	Residue, total	1	1	1.000	26.6	26.6	26.6	%
1-012	Total organic carbon	1	1	1.000	44400.0	44400.0	44400.0	mg/kg
1-013	Ignitability	1	1	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	1	1	1.000	8.8	8.8	8.8	pH
1-015	Reactivity	1	1	1.000	1.0	1.0	1.0	S(-/+)
1-016	Oil and Grease (Retort)	1	1	1.000	73300.0	73300.0	73300.0	mg/kg
67641	2-Propanone	1	1	1.000	702.5	702.5	702.5	ug/kg
75092	Methylene chloride	1	1	1.000	1114.3	1114.3	1114.3	ug/kg
78933	2-Butanone	1	1	1.000	299.4	299.4	299.4	ug/kg
91203	Naphthalene	1	1	1.000	2764.3	2764.3	2764.3	ug/kg
91576	2-Methylnaphthalene	1	1	1.000	13.2	13.2	13.2	ug/kg
100414	Ethylbenzene	1	1	1.000	312.7	312.7	312.7	ug/kg
100425	Styrene	1	1	1.000	11613.7	11613.7	11613.7	ug/kg
108101	4-Methyl-2-pentanone	1	1	1.000	149.0	149.0	149.0	ug/kg
108883	Toluene	1	1	1.000	46.1	46.1	46.1	ug/kg
112403	n-Dodecane	1	1	1.000	6547.0	6547.0	6547.0	ug/kg
112958	n-Eicosane	1	1	1.000	6274.9	6274.9	6274.9	ug/kg
117817	bis(2-Ethylhexyl) phthalate	1	1	1.000	5538.5	5538.5	5538.5	ug/kg
124185	n-Decane	1	1	1.000	4647.1	4647.1	4647.1	ug/kg
544763	n-Hexadecane	1	1	1.000	13829.0	13829.0	13829.0	ug/kg
593453	n-Octadecane	1	1	1.000	5905.9	5905.9	5905.9	ug/kg
629594	n-Tetradecane	1	1	1.000	4133.7	4133.7	4133.7	ug/kg
629970	n-Docosane	1	1	1.000	2157.0	2157.0	2157.0	ug/kg
630013	n-Hexacosane	1	1	1.000	2759.4	2759.4	2759.4	ug/kg
630024	n-Octacosane	1	1	1.000	3214.7	3214.7	3214.7	ug/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------- Site=Central Treatment , Location=Influent , Phase=Solid , Extract=Direct ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
638686	n-Triacontane	1	1	1.000	7073.5	7073.5	7073.5	ug/kg
646311	n-Tetracosane	1	1	1.000	3881.2	3881.2	3881.2	ug/kg
7429905	Aluminum	1	1	1.000	7780.0	7780.0	7780.0	mg/kg
7439896	Iron	1	1	1.000	16600.0	16600.0	16600.0	mg/kg
7439921	Lead	1	1	1.000	102.0	102.0	102.0	mg/kg
7439954	Magnesium	1	1	1.000	5980.0	5980.0	5980.0	mg/kg
7439965	Manganese	1	1	1.000	496.0	496.0	496.0	mg/kg
7440020	Nickel	1	1	1.000	38.0	38.0	38.0	mg/kg
7440235	Sodium	1	1	1.000	9100.0	9100.0	9100.0	mg/kg
7440326	Titanium	1	1	1.000	124.0	124.0	124.0	mg/kg
7440393	Barium	1	1	1.000	25100.0	25100.0	25100.0	mg/kg
7440428	Boron	1	1	1.000	40.0	40.0	40.0	mg/kg
7440439	Cadmium	1	1	1.000	4.0	4.0	4.0	mg/kg
7440473	Chromium	1	1	1.000	169.0	169.0	169.0	mg/kg
7440508	Copper	1	1	1.000	30.0	30.0	30.0	mg/kg
7440666	Zinc	1	1	1.000	688.0	688.0	688.0	mg/kg
7440702	Calcium	1	1	1.000	60900.0	60900.0	60900.0	mg/kg
7664417	Ammonia	1	1	1.000	56.0	56.0	56.0	mg/kg
16984488	Fluoride	1	1	1.000	244.0	244.0	244.0	mg/kg
18496258	Sulfide	1	1	1.000	5830.0	5830.0	5830.0	mg/kg

---------------------------- Site=Central Treatment , Location=Influent , Phase=Solid , Extract=TCLP ----------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
75092	Methylene chloride	1	1	1.000	27.1	27.1	27.1	ug/L
108101	4-Methyl-2-pentanone	1	1	1.000	27.4	27.4	27.4	ug/L
630013	n-Hexacosane	1	1	1.000	64.4	64.4	64.4	ug/L
7439896	Iron	1	1	1.000	711.0	711.0	711.0	ug/L
7439954	Magnesium	1	1	1.000	11800.0	11800.0	11800.0	ug/L
7439965	Manganese	1	1	1.000	2870.0	2870.0	2870.0	ug/L
7440020	Nickel	1	1	1.000	278.0	278.0	278.0	ug/L
7440235	Sodium	1	1	1.000	1480000.0	1480000.0	1480000.0	ug/L
7440315	Tin	1	1	1.000	266.0	266.0	266.0	ug/L
7440382	Arsenic	1	1	1.000	23.0	23.0	23.0	ug/L
7440393	Barium	1	1	1.000	2610.0	2610.0	2610.0	ug/L
7440428	Boron	1	1	1.000	184.0	184.0	184.0	ug/L
7440473	Chromium	1	1	1.000	107.0	107.0	107.0	ug/L
7440666	Zinc	1	1	1.000	1020.0	1020.0	1020.0	ug/L
7440702	Calcium	1	1	1.000	784000.0	784000.0	784000.0	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Central Treatment , Location=Tank , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	2	2	1.000	0.2	60.1	120.0	mg/kg
1-002	Biochemical Oxygen Demand	2	2	1.000	1760.0	2080.0	2400.0	mg/kg
1-003	Chloride	2	2	1.000	57300.0	80150.0	103000.0	mg/kg
1-004	Chemical Oxygen Demand	2	2	1.000	688.0	5494.0	10300.0	mg/kg
1-006	Hydrogen ion	2	2	1.000	2.0	3.9	5.8	pH
1-007	Oil and grease	2	2	1.000	252000.0	276000.0	300000.0	mg/kg
1-008	Residue, total	2	2	1.000	65.4	65.4	65.4	%
1-012	Total organic carbon	2	2	1.000	306000.0	306000.0	306000.0	mg/kg
1-013	Ignitability	2	2	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	2	2	1.000	2.0	3.9	5.8	pH
1-015	Reactivity	2	1	0.500	<DL	0.5	1.0	S(-/+)
1-016	Oil and Grease (Retort)	2	2	1.000	225000.0	271500.0	318000.0	mg/kg
67641	2-Propanone	2	1	0.500	<DL	295074.9	590149.9	ug/kg
71432	Benzene	2	1	0.500	<DL	49137.4	98274.9	ug/kg
71556	1,1,1-Trichloroethane	2	1	0.500	<DL	3124.0	6248.0	ug/kg
75274	Bromodichloromethane	2	1	0.500	<DL	133172.0	266344.0	ug/kg
78933	2-Butanone	2	1	0.500	<DL	191768.7	383537.4	ug/kg
79005	1,1,2-Trichloroethane	2	1	0.500	<DL	134682.4	269364.9	ug/kg
85018	Phenanthrene	2	2	1.000	91109.9	130358.9	169607.9	ug/kg
86737	Fluorene	2	2	1.000	37656.6	65806.3	93955.9	ug/kg
91203	Naphthalene	2	1	0.500	<DL	119490.0	238980.0	ug/kg
91576	2-Methylnaphthalene	2	1	0.500	<DL	39.2	78.4	ug/kg
99876	p-Cymene	2	1	0.500	<DL	54851.6	109703.3	ug/kg
100414	Ethylbenzene	2	1	0.500	<DL	74493.7	148987.4	ug/kg
107131	Acrylonitrile	2	1	0.500	<DL	6948.0	13896.0	ug/kg
108883	Toluene	2	1	0.500	<DL	179043.7	358087.4	ug/kg
108907	Chlorobenzene	2	1	0.500	<DL	125224.9	250449.9	ug/kg
112403	n-Dodecane	2	2	1.000	2350376.6	2485128.3	2619879.9	ug/kg
112958	n-Eicosane	2	2	1.000	1011029.9	1657840.9	2304651.9	ug/kg
117817	bis(2-Ethylhexyl) phthalate	2	2	1.000	37257.3	201492.6	365727.9	ug/kg
124185	n-Decane	2	2	1.000	309995.9	714902.9	1119809.9	ug/kg
544763	n-Hexadecane	2	2	1.000	1946926.6	2938739.3	3930551.9	ug/kg
593453	n-Octadecane	2	2	1.000	829406.6	1556879.3	2284351.9	ug/kg
629594	n-Tetradecane	2	1	0.500	<DL	743146.6	1486293.3	ug/kg
629970	n-Docosane	2	2	1.000	764329.9	1233354.9	1702379.9	ug/kg
630013	n-Hexacosane	2	2	1.000	734876.6	1425770.3	2116663.9	ug/kg
630024	n-Octacosane	2	2	1.000	372193.3	1247280.6	2122367.9	ug/kg
638686	n-Triacontane	2	2	1.000	326639.9	2297779.9	4268919.9	ug/kg
646311	n-Tetracosane	2	2	1.000	852573.3	1470724.6	2088875.9	ug/kg
832699	1-Methylphenanthrene	2	1	0.500	<DL	12.3	24.7	ug/kg
1730376	1-Methylfluorene	2	1	0.500	<DL	22.1	44.2	ug/kg
7429905	Aluminum	2	1	0.500	<DL	239.0	478.0	mg/kg
7439896	Iron	2	2	1.000	392.0	1386.0	2380.0	mg/kg
7439954	Magnesium	2	1	0.500	<DL	129.5	259.0	mg/kg
7439965	Manganese	2	2	1.000	4.0	13.5	23.0	mg/kg
7439976	Mercury	2	1	0.500	<DL	2.7	5.5	mg/kg
7440235	Sodium	2	2	1.000	344.0	3082.0	5820.0	mg/kg
7440246	Strontium	2	1	0.500	<DL	124.5	249.0	mg/kg
7440393	Barium	2	1	0.500	<DL	670.0	1340.0	mg/kg
7440473	Chromium	2	1	0.500	<DL	3.5	7.0	mg/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Central Treatment , Location=Tank , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
7440508	Copper	2	1	0.500	<DL	8.0	16.0	mg/kg
7440666	Zinc	2	2	1.000	11.0	47.5	84.0	mg/kg
7440702	Calcium	2	2	1.000	144.0	2697.0	5250.0	mg/kg
7664417	Ammonia	2	1	0.500	<DL	0.1	0.3	mg/kg
7704349	Sulfur	2	2	1.000	353.0	1391.5	2430.0	mg/kg
7723140	Phosphorus (black, white, red, yell	2	1	0.500	<DL	452.0	904.0	mg/kg
16984488	Fluoride	2	2	1.000	26.0	46.0	66.0	mg/kg
18496258	Sulfide	2	1	0.500	<DL	3.0	6.0	mg/kg

------------------------------ Site=Central Treatment , Location=Tank , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	1	1	1.000	538.6	538.6	538.6	ug/L
71432	Benzene	1	1	1.000	107.6	107.6	107.6	ug/L
91203	Naphthalene	1	1	1.000	64.5	64.5	64.5	ug/L
91576	2-Methylnaphthalene	1	1	1.000	61.9	61.9	61.9	ug/L
100414	Ethylbenzene	1	1	1.000	46.7	46.7	46.7	ug/L
108101	4-Methyl-2-pentanone	1	1	1.000	41.3	41.3	41.3	ug/L
108883	Toluene	1	1	1.000	199.6	199.6	199.6	ug/L
117817	bis(2-Ethylhexyl) phthalate	1	1	1.000	15.1	15.1	15.1	ug/L
7429905	Aluminum	2	1	0.500	<DL	163.0	326.0	ug/L
7439896	Iron	2	2	1.000	348.0	9824.0	19300.0	ug/L
7439954	Magnesium	2	1	0.500	<DL	2980.0	5960.0	ug/L
7439965	Manganese	2	2	1.000	16.0	169.0	322.0	ug/L
7440235	Sodium	2	2	1.000	1370000.0	1420000.0	1470000.0	ug/L
7440246	Strontium	2	1	0.500	<DL	2265.0	4530.0	ug/L
7440393	Barium	2	2	1.000	305.0	1632.5	2960.0	ug/L
7440428	Boron	2	1	0.500	<DL	131.5	263.0	ug/L
7440666	Zinc	2	2	1.000	161.0	163.5	166.0	ug/L
7440702	Calcium	2	2	1.000	2520.0	71260.0	140000.0	ug/L
7704349	Sulfur	2	2	1.000	5490.0	8345.0	11200.0	ug/L
7723140	Phosphorus (black, white, red, yell	2	1	0.500	<DL	2485.0	4970.0	ug/L

------------------------------ Site=Drilling , Location=Drilling Mud , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-008	Residue, total	1	1	1.000	12.0	12.0	12.0	%
67641	2-Propanone	2	1	0.679	<DL	1193.3	1756.6	ug/kg
75092	Methylene chloride	2	1	0.679	<DL	10.0	14.8	ug/kg
78933	2-Butanone	2	1	0.679	<DL	537.5	791.2	ug/kg
84662	Diethyl phthalate	2	1	0.679	<DL	1448.8	2132.7	ug/kg
85018	Phenanthrene	2	1	0.679	<DL	707.1	1040.9	ug/kg
91576	2-Methylnaphthalene	2	1	0.679	<DL	14.3	21.1	ug/kg
100414	Ethylbenzene	2	1	0.679	<DL	33.6	49.5	ug/kg
108883	Toluene	2	1	0.679	<DL	68.6	100.9	ug/kg
112403	n-Dodecane	2	1	0.679	<DL	1186.1	1745.9	ug/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Drilling , Location=Drilling Mud , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
112958	n-Eicosane	2	1	0.679	<DL	1226.5	1805.5	ug/kg
117817	bis(2-Ethylhexyl) phthalate	2	1	0.679	<DL	994.5	1463.9	ug/kg
544763	n-Hexadecane	2	1	0.679	<DL	2814.8	4143.5	ug/kg
593453	n-Octadecane	2	1	0.679	<DL	4953.2	7291.2	ug/kg
629594	n-Tetradecane	2	1	0.679	<DL	2763.4	4067.9	ug/kg
7429905	Aluminum	1	1	1.000	7190.0	7190.0	7190.0	mg/kg
7439896	Iron	1	1	1.000	26700.0	26700.0	26700.0	mg/kg
7439954	Magnesium	1	1	1.000	3500.0	3500.0	3500.0	mg/kg
7439965	Manganese	1	1	1.000	255.0	255.0	255.0	mg/kg
7440213	Silicon	1	1	1.000	1300.0	1300.0	1300.0	mg/kg
7440235	Sodium	1	1	1.000	1500.0	1500.0	1500.0	mg/kg
7440326	Titanium	1	1	1.000	82.0	82.0	82.0	mg/kg
7440393	Barium	1	1	1.000	5390.0	5390.0	5390.0	mg/kg
7440473	Chromium	1	1	1.000	189.0	189.0	189.0	mg/kg
7440508	Copper	1	1	1.000	32.0	32.0	32.0	mg/kg
7440666	Zinc	1	1	1.000	156.0	156.0	156.0	mg/kg
7440702	Calcium	1	1	1.000	18600.0	18600.0	18600.0	mg/kg
7704349	Sulfur	1	1	1.000	14500.0	14500.0	14500.0	mg/kg
7723140	Phosphorus (black, white, red, yell	1	1	1.000	1360.0	1360.0	1360.0	mg/kg

------------------------------ Site=Drilling , Location=Drilling Mud , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	2	2	1.000	157.4	177.9	187.6	ug/L
75092	Methylene chloride	2	1	0.321	<DL	5.5	17.3	ug/L
91576	2-Methylnaphthalene	2	1	0.679	<DL	15.4	22.7	ug/L
108101	4-Methyl-2-pentanone	2	1	0.679	<DL	13.2	19.5	ug/L
117817	bis(2-Ethylhexyl) phthalate	2	2	1.000	20.0	29.0	48.2	ug/L
124185	n-Decane	2	1	0.679	<DL	1744.5	2568.0	ug/L
7429905	Aluminum	1	1	1.000	307.0	307.0	307.0	ug/L
7439896	Iron	1	1	1.000	11100.0	11100.0	11100.0	ug/L
7439954	Magnesium	1	1	1.000	7870.0	7870.0	7870.0	ug/L
7439965	Manganese	1	1	1.000	628.0	628.0	628.0	ug/L
7440020	Nickel	1	1	1.000	40.0	40.0	40.0	ug/L
7440213	Silicon	1	1	1.000	12700.0	12700.0	12700.0	ug/L
7440235	Sodium	1	1	1.000	1340000.0	1340000.0	1340000.0	ug/L
7440393	Barium	1	1	1.000	944.0	944.0	944.0	ug/L
7440428	Boron	1	1	1.000	174.0	174.0	174.0	ug/L
7440473	Chromium	1	1	1.000	387.0	387.0	387.0	ug/L
7440666	Zinc	1	1	1.000	552.0	552.0	552.0	ug/L
7440702	Calcium	1	1	1.000	96600.0	96600.0	96600.0	ug/L
7704349	Sulfur	1	1	1.000	13800.0	13800.0	13800.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

---------------------------------- Site=Drilling , Location=Pit , Phase=Liquid , Extract=Direct ----------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	17	16	0.876	<DL	5.5	13.0	mg/L
1-002	Biochemical Oxygen Demand	17	17	1.000	5.0	493.2	12000.0	mg/L
1-003	Chloride	17	17	1.000	198.0	6686.7	47000.0	mg/L
1-004	Chemical Oxygen Demand	17	17	1.000	130.0	5086.2	85000.0	mg/L
1-005	Nitrate/nitrite	17	14	0.975	<DL	5.7	85.0	mg/L
1-006	Hydrogen ion	17	17	1.000	6.5	7.7	12.7	pH
1-007	Oil and grease	17	17	1.000	3.0	482.1	18300.0	mg/L
1-008	Residue, total	1	1	1.000	41.0	41.0	41.0	%
1-009	Residue, non-filterable	16	16	1.000	224.0	18386.0	107000.0	mg/L
1-010	Residue, filterable	16	15	0.999	<DL	38241.8	178000.0	mg/L
1-011	Specific conductivity	17	17	1.000	1150.0	88146.9	400000.0	umho/cm
1-012	Total organic carbon	17	17	1.000	15.0	449.9	75500.0	mg/L
1-013	Ignitability	17	17	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	17	17	1.000	6.5	7.7	12.7	pH
1-015	Reactivity	17	3	0.171	<DL	0.1	1.0	S(-/+)
57125	Cyanides (soluble salts and complex	17	4	0.640	<DL	49.1	80.0	ug/L
58902	2,3,4,6-Tetrachlorophenol	15	1	0.063	<DL	72.0	1136.2	ug/L
65850	Benzoic acid	15	3	0.074	<DL	12.1	185.0	ug/L
67641	2-Propanone	16	12	0.891	<DL	1333.0	5330.2	ug/L
71432	Benzene	16	1	0.055	<DL	0.9	16.5	ug/L
75092	Methylene chloride	16	12	0.574	<DL	8158.1	124850.9	ug/L
75150	Carbon disulfide	16	2	0.009	<DL	0.1	22.4	ug/L
78591	Isophorone	15	1	0.411	<DL	4.1	10.1	ug/L
78933	2-Butanone	16	6	0.076	<DL	7.2	1602.5	ug/L
79005	1,1,2-Trichloroethane	16	1	0.000	<DL	0.0	138.2	ug/L
85018	Phenanthrene	15	3	0.507	<DL	208.1	5990.2	ug/L
86737	Fluorene	15	2	0.411	<DL	10.8	1464.7	ug/L
87865	Pentachlorophenol	15	1	0.063	<DL	3826.3	66342.3	ug/L
91203	Naphthalene	15	5	0.512	<DL	43.8	1357.5	ug/L
91576	2-Methylnaphthalene	15	6	0.516	<DL	80.9	8725.0	ug/L
91941	3,3'-Dichlorobenzidine	15	1	0.096	<DL	7.1	74.9	ug/L
92524	Biphenyl	15	1	0.411	<DL	25.4	61.8	ug/L
98862	Acetophenone	15	2	0.007	<DL	0.1	24.4	ug/L
99876	p-Cymene	15	3	0.508	<DL	16.4	42.9	ug/L
100414	Ethylbenzene	16	2	0.005	<DL	0.1	227.8	ug/L
105679	2,4-Dimethylphenol	15	1	0.004	<DL	0.0	10.7	ug/L
107028	2-Propenal	16	1	0.055	<DL	2.7	50.5	ug/L
108101	4-Methyl-2-pentanone	15	6	0.559	<DL	26.3	1963.2	ug/L
108883	Toluene	16	6	0.779	<DL	186.6	442.4	ug/L
108907	Chlorobenzene	16	1	0.001	<DL	0.0	34.2	ug/L
108952	Phenol	15	3	0.067	<DL	3.8	315.1	ug/L
112403	n-Dodecane	15	7	0.516	<DL	2345.6	40654.2	ug/L
112958	n-Eicosane	15	11	0.594	<DL	4094.2	89800.9	ug/L
117817	bis(2-Ethylhexyl) phthalate	15	5	0.110	<DL	2.1	1419.9	ug/L
117840	Di-n-octyl phthalate	15	1	0.000	<DL	0.0	1347.9	ug/L
123911	1,4-Dioxane	16	1	0.003	<DL	0.6	189.0	ug/L
124185	n-Decane	15	6	0.516	<DL	764.2	20824.2	ug/L
132649	Dibenzofuran	15	1	0.001	<DL	0.0	21.2	ug/L
142621	hexanoic acid	15	2	0.159	<DL	8.8	74.9	ug/L
544763	n-Hexadecane	15	10	0.834	<DL	4733.2	170361.9	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------- Site=Drilling , Location=Pit , Phase=Liquid , Extract=Direct -------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
591786	2-Hexanone	16	1	0.003	<DL	0.0	14.4	ug/L
593453	n-Octadecane	15	9	0.586	<DL	2510.6	41719.7	ug/L
615225	2-(methylthio)benzothiazole	15	2	0.004	<DL	0.1	90.2	ug/L
629594	n-Tetradecane	15	8	0.527	<DL	2658.6	83588.5	ug/L
629970	n-Docosane	15	5	0.520	<DL	533.3	25898.3	ug/L
630013	n-Hexacosane	15	2	0.507	<DL	3062.4	7246.7	ug/L
630024	n-Octacosane	15	2	0.507	<DL	83.6	442.9	ug/L
638686	n-Triacontane	15	3	0.108	<DL	90.2	9609.4	ug/L
646311	n-Tetracosane	15	5	0.520	<DL	892.5	8795.3	ug/L
832699	1-Methylphenanthrene	15	2	0.507	<DL	246.3	2009.7	ug/L
7429905	Aluminum	17	16	0.998	<DL	202058.6	3760000.0	ug/L
7439896	Iron	17	16	0.998	<DL	366030.3	6310000.0	ug/L
7439910	Lanthanum	17	1	0.000	<DL	0.0	1240.0	ug/L
7439921	Lead	17	12	0.364	<DL	693.7	52000.0	ug/L
7439932	Lithium	17	7	0.323	<DL	532.3	9000.0	ug/L
7439954	Magnesium	17	17	1.000	692.0	178942.7	3400000.0	ug/L
7439965	Manganese	17	17	1.000	108.0	5228.2	117000.0	ug/L
7439976	Mercury	17	3	0.162	<DL	0.4	6.0	ug/L
7439987	Molybdenum	17	13	0.406	<DL	123.1	577.0	ug/L
7440020	Nickel	17	15	0.997	<DL	306.5	6090.0	ug/L
7440097	Potassium	17	15	0.998	<DL	2280009.9	3980000.0	ug/L
7440213	Silicon	17	16	0.974	<DL	69350.8	1020000.0	ug/L
7440224	Silver	17	7	0.205	<DL	0.4	19.0	ug/L
7440235	Sodium	17	17	1.000	185000.0	13142056.6	59100000.0	ug/L
7440246	Strontium	17	17	1.000	1110.0	24300.4	592000.0	ug/L
7440291	Thorium	17	1	0.000	<DL	0.0	1630.0	ug/L
7440315	Tin	17	12	0.404	<DL	295.1	2270.0	ug/L
7440326	Titanium	17	12	0.871	<DL	550.6	32400.0	ug/L
7440360	Antimony	17	1	0.003	<DL	0.2	68.0	ug/L
7440382	Arsenic	17	6	0.251	<DL	43.7	222.0	ug/L
7440393	Barium	17	17	1.000	192.0	42414.2	18700000.0	ug/L
7440417	Beryllium	17	9	0.384	<DL	9.7	36.0	ug/L
7440428	Boron	17	16	0.998	<DL	16929.4	49900.0	ug/L
7440439	Cadmium	17	13	0.406	<DL	58.3	2230.0	ug/L
7440451	Cerium	17	3	0.329	<DL	402.8	1640.0	ug/L
7440473	Chromium	17	14	0.406	<DL	1355.8	327000.0	ug/L
7440484	Cobalt	17	9	0.384	<DL	123.6	504.0	ug/L
7440508	Copper	17	13	0.404	<DL	363.7	35800.0	ug/L
7440622	Vanadium	17	11	0.402	<DL	284.7	1730.0	ug/L
7440655	Yttrium	17	10	0.363	<DL	122.7	18000.0	ug/L
7440666	Zinc	17	17	1.000	30.0	1539.9	100000.0	ug/L
7440699	Bismuth	17	1	0.002	<DL	1.7	1030.0	ug/L
7440702	Calcium	17	17	1.000	174000.0	1059199.3	24000000.0	ug/L
7553562	Iodine	17	1	0.002	<DL	2.2	1350.0	ug/L
7664417	Ammonia	17	17	1.000	0.1	3.4	46.0	mg/L
7704349	Sulfur	17	15	0.976	<DL	230393.4	5850000.0	ug/L
7723140	Phosphorus (black, white, red, yell	17	13	0.995	<DL	5682.9	19300.0	ug/L
16984488	Fluoride	17	17	1.000	0.8	10.1	310.0	mg/L
18496258	Sulfide	17	3	0.171	<DL	0.0	350.0	mg/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------------ Site=Drilling , Location=Pit , Phase=Solid , Extract=Direct ------------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	20	18	0.995	<DL	15.4	120.0	mg/kg
1-002	Biochemical Oxygen Demand	20	20	1.000	4.0	2852.3	18400.0	mg/kg
1-003	Chloride	20	20	1.000	571.0	38976.2	135000.0	mg/kg
1-004	Chemical Oxygen Demand	20	20	1.000	1580.0	110457.5	906000.0	mg/kg
1-005	Nitrate/nitrite	20	14	0.964	<DL	76.8	611.0	mg/kg
1-006	Hydrogen ion	20	20	1.000	6.8	9.0	12.8	pH
1-007	Oil and grease	20	20	1.000	798.0	32742.0	282000.0	mg/kg
1-008	Residue, total	21	21	1.000	14.8	32.9	69.5	%
1-012	Total organic carbon	20	20	1.000	8330.0	34336.6	114000.0	mg/kg
1-013	Ignitability	20	20	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	20	20	1.000	6.8	9.0	12.8	pH
1-015	Reactivity	20	5	0.467	<DL	0.4	1.0	S(-/+)
1-016	Oil and Grease (Retort)	20	20	1.000	1950.0	24134.3	220000.0	mg/kg
1_331	Tetrachlorodibenzo-p-dioxins	4	2	0.894	<DL	6.3	7.2	ng/kg
65850	Benzoic acid	19	1	0.005	<DL	0.1	30.2	ug/kg
67641	2-Propanone	18	13	0.877	<DL	24087.2	32647.9	ug/kg
71432	Benzene	18	7	0.732	<DL	96.0	1420.5	ug/kg
71556	1,1,1-Trichloroethane	18	1	0.105	<DL	1.6	16.0	ug/kg
75092	Methylene chloride	18	5	0.242	<DL	276.9	2279.6	ug/kg
75150	Carbon disulfide	18	2	0.574	<DL	11.8	20.5	ug/kg
78933	2-Butanone	18	6	0.843	<DL	14300.6	44695.9	ug/kg
79005	1,1,2-Trichloroethane	18	1	0.105	<DL	6.3	60.3	ug/kg
79345	1,1,2,2-Tetrachloroethane	18	1	0.000	<DL	0.0	84.1	ug/kg
85018	Phenanthrene	19	1	0.005	<DL	14.0	2571.3	ug/kg
86737	Fluorene	19	1	0.005	<DL	5.6	1038.5	ug/kg
87865	Pentachlorophenol	19	1	0.019	<DL	5112.5	274320.7	ug/kg
91203	Naphthalene	·19	7	0.160	<DL	47123.5	446266.6	ug/kg
91576	2-Methylnaphthalene	19	9	0.662	<DL	12.0	112.0	ug/kg
92524	Biphenyl	19	2	0.006	<DL	6.5	1187.2	ug/kg
99876	p-Cymene	19	3	0.106	<DL	13852.9	131327.9	ug/kg
100414	Ethylbenzene	18	7	0.723	<DL	1450.7	12241.1	ug/kg
100425	Styrene	19	1	0.005	<DL	359.4	65802.6	ug/kg
108101	4-Methyl-2-pentanone	19	4	0.034	<DL	0.9	32.4	ug/kg
108883	Toluene	18	9	0.848	<DL	1209.9	6292.3	ug/kg
108907	Chlorobenzene	18	1	0.032	<DL	0.8	25.3	ug/kg
108952	Phenol	19	1	0.005	<DL	45.3	8309.4	ug/kg
112403	n-Dodecane	19	13	0.802	<DL	245821.2	2272826.6	ug/kg
112958	n-Eicosane	19	14	0.927	<DL	154434.4	1397026.6	ug/kg
117817	bis(2-Ethylhexyl) phthalate	19	9	0.816	<DL	3440.4	8522.3	ug/kg
124185	n-Decane	19	9	0.634	<DL	1645.1	19386.4	ug/kg
127184	Tetrachlorethene	18	1	0.000	<DL	0.0	73.7	ug/kg
132650	Dibenzothiophene	19	1	0.005	<DL	4.1	768.4	ug/kg
544763	n-Hexadecane	19	16	0.932	<DL	593974.6	5500293.3	ug/kg
593453	n-Octadecane	19	15	0.932	<DL	154639.0	1409446.6	ug/kg
629594	n-Tetradecane	19	14	0.806	<DL	164291.8	1516013.3	ug/kg
629970	n-Docosane	19	10	0.911	<DL	81886.8	745479.9	ug/kg
630013	n-Hexacosane	19	8	0.882	<DL	55001.2	444672.6	ug/kg
630024	n-Octacosane	19	6	0.816	<DL	29678.5	189633.3	ug/kg
638686	n-Triacontane	19	6	0.855	<DL	30040.5	55331.9	ug/kg
646311	n-Tetracosane	19	9	0.877	<DL	63493.6	530537.9	ug/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------------ Site=Drilling , Location=Pit , Phase=Solid , Extract=Direct ------------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
832699	1-Methylphenanthrene	19	4	0.042	<DL	0.9	25.8	ug/kg
1746016	2,3,7,8-Tetrachlorodibenzo-p-dioxin	4	2	0.894	<DL	9.2	13.6	ng/kg
7429905	Aluminum	21	21	1.000	2320.0	9682.9	21300.0	mg/kg
7439896	Iron	21	21	1.000	3090.0	23576.7	56800.0	mg/kg
7439921	Lead	21	12	0.440	<DL	79.5	446.0	mg/kg
7439954	Magnesium	21	21	1.000	1420.0	6538.3	16400.0	mg/kg
7439965	Manganese	21	21	1.000	117.0	446.7	940.0	mg/kg
7439976	Mercury	21	3	0.044	<DL	0.0	2.1	mg/kg
7439987	Molybdenum	21	2	0.039	<DL	0.6	16.0	mg/kg
7440020	Nickel	21	15	0.865	<DL	25.3	61.0	mg/kg
7440097	Potassium	21	10	0.169	<DL	3047.0	173000.0	mg/kg
7440213	Silicon	21	15	0.426	<DL	1729.4	14600.0	mg/kg
7440224	Silver	21	6	0.059	<DL	0.0	9.1	mg/kg
7440235	Sodium	21	21	1.000	580.0	27098.3	67400.0	mg/kg
7440246	Strontium	21	8	0.437	<DL	155.7	1090.0	mg/kg
7440315	Tin	21	8	0.243	<DL	13.2	101.0	mg/kg
7440326	Titanium	21	21	1.000	17.0	143.9	554.0	mg/kg
7440382	Arsenic	21	11	0.339	<DL	4.1	29.0	mg/kg
7440393	Barium	21	21	1.000	30.0	8921.1	56200.0	mg/kg
7440417	Beryllium	21	3	0.020	<DL	0.0	3.0	mg/kg
7440428	Boron	21	18	0.703	<DL	75.2	290.0	mg/kg
7440439	Cadmium	21	13	0.882	<DL	4.0	14.0	mg/kg
7440473	Chromium	21	20	0.928	<DL	33.7	368.0	mg/kg
7440484	Cobalt	21	5	0.010	<DL	0.1	17.0	mg/kg
7440508	Copper	21	18	0.995	<DL	35.0	82.0	mg/kg
7440622	Vanadium	21	15	0.481	<DL	12.0	74.0	mg/kg
7440655	Yttrium	21	2	0.017	<DL	0.1	12.0	mg/kg
7440666	Zinc	21	21	1.000	22.0	139.3	823.0	mg/kg
7440702	Calcium	21	21	1.000	9360.0	40147.3	144000.0	mg/kg
7664417	Ammonia	20	18	1.000	<DL	40.2	4700.0	mg/kg
7704349	Sulfur	21	21	1.000	1170.0	6970.4	19900.0	mg/kg
7723140	Phosphorus (black, white, red, yell	21	15	0.216	<DL	84.4	3090.0	mg/kg
16984488	Fluoride	20	20	1.000	5.4	475.5	1800.0	mg/kg
18496258	Sulfide	20	4	0.435	<DL	703.8	1680.0	mg/kg

------------------------------------ Site=Drilling , Location=Pit , Phase=Solid , Extract=TCLP ------------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
59507	4-Chloro-3-methylphenol	15	1	0.000	<DL	0.0	31.9	ug/L
65850	Benzoic acid	15	2	0.097	<DL	11.0	132.6	ug/L
67641	2-Propanone	18	12	0.170	<DL	54.6	12005.9	ug/L
71432	Benzene	18	1	0.000	<DL	0.0	19.0	ug/L
75092	Methylene chloride	18	14	0.964	<DL	26.2	60.4	ug/L
84662	Diethyl phthalate	18	1	0.007	<DL	2.2	308.7	ug/L
84742	Di-n-butyl phthalate	18	1	0.005	<DL	0.0	20.1	ug/L
87865	Pentachlorophenol	15	1	0.061	<DL	990.6	16221.1	ug/L
91203	Naphthalene	18	5	0.150	<DL	217.9	2061.4	ug/L
91576	2-Methylnaphthalene	18	9	0.768	<DL	39.9	285.5	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------------ Site=Drilling , Location=Pit , Phase=Solid , Extract=TCLP ------------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
100414	Ethylbenzene	18	3	0.150	<DL	2.5	96.4	ug/L
108101	4-Methyl-2-pentanone	18	12	0.860	<DL	17.4	52.7	ug/L
108883	Toluene	18	8	0.762	<DL	12.8	99.7	ug/L
108952	Phenol	18	1	0.011	<DL	1.2	116.3	ug/L
117817	bis(2-Ethylhexyl) phthalate	18	8	0.216	<DL	5.4	106.1	ug/L
124185	n-Decane	18	2	0.043	<DL	21.7	672.8	ug/L
142621	hexanoic acid	15	2	0.381	<DL	31.7	87.5	ug/L
593453	n-Octadecane	18	1	0.105	<DL	83.4	790.6	ug/L
615225	2-(methylthio)benzothiazole	18	1	0.002	<DL	0.0	33.0	ug/L
629594	n-Tetradecane	18	1	0.105	<DL	103.1	978.1	ug/L
630013	n-Hexacosane	18	1	0.120	<DL	8.1	67.6	ug/L
638686	n-Triacontane	18	1	0.105	<DL	11.0	104.4	ug/L
646311	n-Tetracosane	18	1	0.105	<DL	67.9	644.3	ug/L
7429905	Aluminum	21	11	0.817	<DL	1670.9	12300.0	ug/L
7439896	Iron	21	20	0.986	<DL	7111.2	56200.0	ug/L
7439921	Lead	21	8	0.807	<DL	582.0	830.0	ug/L
7439954	Magnesium	21	21	1.000	6700.0	24876.9	95500.0	ug/L
7439965	Manganese	21	21	1.000	1130.0	2751.5	7060.0	ug/L
7439976	Mercury	20	1	0.072	<DL	0.2	3.6	ug/L
7439987	Molybdenum	21	2	0.237	<DL	24.8	105.0	ug/L
7440020	Nickel	21	11	0.647	<DL	91.1	181.0	ug/L
7440097	Potassium	21	10	0.169	<DL	17023.4	171000.0	ug/L
7440213	Silicon	21	14	0.413	<DL	25836.9	119000.0	ug/L
7440224	Silver	21	1	0.004	<DL	0.0	21.0	ug/L
7440235	Sodium	21	21	1.000	25300.0	1065826.8	7350000.0	ug/L
7440246	Strontium	21	8	0.437	<DL	3695.5	23600.0	ug/L
7440315	Tin	21	13	0.964	<DL	358.2	531.0	ug/L
7440326	Titanium	21	1	0.072	<DL	4.0	57.0	ug/L
7440393	Barium	21	21	1.000	312.0	1494.0	3870.0	ug/L
7440417	Beryllium	21	1	0.003	<DL	0.0	7.0	ug/L
7440428	Boron	21	16	0.822	<DL	716.1	4010.0	ug/L
7440439	Cadmium	21	10	0.425	<DL	23.2	363.0	ug/L
7440473	Chromium	21	7	0.577	<DL	76.6	1680.0	ug/L
7440484	Cobalt	21	1	0.417	<DL	642.8	1540.0	ug/L
7440508	Copper	21	6	0.654	<DL	50.9	241.0	ug/L
7440655	Yttrium	21	2	0.080	<DL	4.0	64.0	ug/L
7440666	Zinc	21	21	1.000	70.0	5782.9	11100.0	ug/L
7440702	Calcium	20	20	1.000	224000.0	1133899.6	2220000.0	ug/L
7704349	Sulfur	21	21	1.000	3590.0	34414.6	122000.0	ug/L
7723140	Phosphorus (black, white, red, yell	21	3	0.011	<DL	2.6	553.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Drilling , Location=Tank Bottom , Phase=Liquid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	1	1	1.000	680.0	680.0	680.0	mg/L
1-002	Biochemical Oxygen Demand	1	1	1.000	630.0	630.0	630.0	mg/L
1-003	Chloride	1	1	1.000	8500.0	8500.0	8500.0	mg/L
1-004	Chemical Oxygen Demand	1	1	1.000	5500.0	5500.0	5500.0	mg/L
1-005	Nitrate/nitrite	1	1	1.000	325.0	325.0	325.0	mg/L
1-007	Oil and grease	1	1	1.000	129000.0	129000.0	129000.0	mg/L
1-009	Residue, non-filterable	1	1	1.000	79000.0	79000.0	79000.0	mg/L
1-010	Residue, filterable	1	1	1.000	9800.0	9800.0	9800.0	mg/L
1-012	Total organic carbon	1	1	1.000	110000.0	110000.0	110000.0	mg/L
1-013	Ignitability	1	1	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	1	1	1.000	7.1	7.1	7.1	pH
7429905	Aluminum	1	1	1.000	757000.0	757000.0	757000.0	ug/L
7439896	Iron	1	1	1.000	7150000.0	7150000.0	7150000.0	ug/L
7439921	Lead	1	1	1.000	53100.0	53100.0	53100.0	ug/L
7439954	Magnesium	1	1	1.000	669000.0	669000.0	669000.0	ug/L
7439965	Manganese	1	1	1.000	39700.0	39700.0	39700.0	ug/L
7440020	Nickel	1	1	1.000	12200.0	12200.0	12200.0	ug/L
7440213	Silicon	1	1	1.000	2860.0	2860.0	2860.0	ug/L
7440235	Sodium	1	1	1.000	3840000.0	3840000.0	3840000.0	ug/L
7440246	Strontium	1	1	1.000	908.0	908.0	908.0	ug/L
7440315	Tin	1	1	1.000	12300.0	12300.0	12300.0	ug/L
7440326	Titanium	1	1	1.000	43800.0	43800.0	43800.0	ug/L
7440393	Barium	1	1	1.000	647000.0	647000.0	647000.0	ug/L
7440428	Boron	1	1	1.000	44300.0	44300.0	44300.0	ug/L
7440473	Chromium	1	1	1.000	46000.0	46000.0	46000.0	ug/L
7440508	Copper	1	1	1.000	66100.0	66100.0	66100.0	ug/L
7440622	Vanadium	1	1	1.000	5480.0	5480.0	5480.0	ug/L
7440666	Zinc	1	1	1.000	38900.0	38900.0	38900.0	ug/L
7440702	Calcium	1	1	1.000	4710000.0	4710000.0	4710000.0	ug/L
7664417	Ammonia	1	1	1.000	88.0	88.0	88.0	mg/L
7704349	Sulfur	1	1	1.000	27100.0	27100.0	27100.0	ug/L
7723140	Phosphorus (black, white, red, yell	1	1	1.000	1100.0	1100.0	1100.0	ug/L
16984488	Fluoride	1	1	1.000	73.0	73.0	73.0	mg/L
18496258	Sulfide	1	1	1.000	4170.0	4170.0	4170.0	mg/L

------------------------------ Site=Drilling , Location=Tank Bottom , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	1	1	1.000	391037.4	391037.4	391037.4	ug/kg
71432	Benzene	1	1	1.000	66387.4	66387.4	66387.4	ug/kg
85018	Phenanthrene	1	1	1.000	32119.9	32119.9	32119.9	ug/kg
91203	Naphthalene	1	1	1.000	100131.9	100131.9	100131.9	ug/kg
91576	2-Methylnaphthalene	1	1	1.000	148.1	148.1	148.1	ug/kg
99876	p-Cymene	1	1	1.000	41389.9	41389.9	41389.9	ug/kg
100414	Ethylbenzene	1	1	1.000	73449.9	73449.9	73449.9	ug/kg
108101	4-Methyl-2-pentanone	1	1	1.000	40.8	40.8	40.8	ug/kg
108883	Toluene	1	1	1.000	206743.7	206743.7	206743.7	ug/kg
112403	n-Dodecane	1	1	1.000	1311787.9	1311787.9	1311787.9	ug/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------- Site=Drilling , Location=Tank Bottom , Phase=Solid , Extract=Direct --------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
112958	n-Eicosane	1	1	1.000	870115.9	870115.9	870115.9	ug/kg
117817	bis(2-Ethylhexyl) phthalate	1	1	1.000	104855.9	104855.9	104855.9	ug/kg
124185	n-Decane	1	1	1.000	1861337.9	1861337.9	1861337.9	ug/kg
544763	n-Hexadecane	1	1	1.000	1011271.9	1011271.9	1011271.9	ug/kg
593453	n-Octadecane	1	1	1.000	1022227.9	1022227.9	1022227.9	ug/kg
629594	n-Tetradecane	1	1	1.000	1239559.9	1239559.9	1239559.9	ug/kg
629970	n-Docosane	1	1	1.000	843535.9	843535.9	843535.9	ug/kg
630013	n-Hexacosane	1	1	1.000	301511.9	301511.9	301511.9	ug/kg
630024	n-Octacosane	1	1	1.000	81553.9	81553.9	81553.9	ug/kg
638686	n-Triacontane	1	1	1.000	445727.9	445727.9	445727.9	ug/kg
646311	n-Tetracosane	1	1	1.000	538859.9	538859.9	538859.9	ug/kg
832699	1-Methylphenanthrene	1	1	1.000	39.5	39.5	39.5	ug/kg

------------------------------- Site=Drilling , Location=Tank Bottom , Phase=Solid , Extract=TCLP --------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	1	1	1.000	2610.6	2610.6	2610.6	ug/L
71432	Benzene	1	1	1.000	325.5	325.5	325.5	ug/L
78933	2-Butanone	1	1	1.000	64.5	64.5	64.5	ug/L
91203	Naphthalene	1	1	1.000	12407.5	12407.5	12407.5	ug/L
91576	2-Methylnaphthalene	1	1	1.000	6836.9	6836.9	6836.9	ug/L
100414	Ethylbenzene	1	1	1.000	196.2	196.2	196.2	ug/L
108101	4-Methyl-2-pentanone	1	1	1.000	79.5	79.5	79.5	ug/L
108883	Toluene	1	1	1.000	494.0	494.0	494.0	ug/L
112403	n-Dodecane	1	1	1.000	133472.9	133472.9	133472.9	ug/L
112958	n-Eicosane	1	1	1.000	40747.3	40747.3	40747.3	ug/L
124185	n-Decane	1	1	1.000	147444.9	147444.9	147444.9	ug/L
544763	n-Hexadecane	1	1	1.000	140523.9	140523.9	140523.9	ug/L
629594	n-Tetradecane	1	1	1.000	110332.9	110332.9	110332.9	ug/L
629970	n-Docosane	1	1	1.000	75365.5	75365.5	75365.5	ug/L
630013	n-Hexacosane	1	1	1.000	12727.1	12727.1	12727.1	ug/L
630024	n-Octacosane	1	1	1.000	7719.0	7719.0	7719.0	ug/L
646311	n-Tetracosane	1	1	1.000	31167.4	31167.4	31167.4	ug/L
7429905	Aluminum	1	1	1.000	227.0	227.0	227.0	ug/L
7439896	Iron	1	1	1.000	173000.0	173000.0	173000.0	ug/L
7439954	Magnesium	1	1	1.000	17800.0	17800.0	17800.0	ug/L
7439965	Manganese	1	1	1.000	1920.0	1920.0	1920.0	ug/L
7439987	Molybdenum	1	1	1.000	122.0	122.0	122.0	ug/L
7440020	Nickel	1	1	1.000	527.0	527.0	527.0	ug/L
7440235	Sodium	1	1	1.000	14000000.0	14000000.0	14000000.0	ug/L
7440315	Tin	1	1	1.000	402.0	402.0	402.0	ug/L
7440393	Barium	1	1	1.000	4830.0	4830.0	4830.0	ug/L
7440428	Boron	1	1	1.000	1580.0	1580.0	1580.0	ug/L
7440666	Zinc	1	1	1.000	242.0	242.0	242.0	ug/L
7440702	Calcium	1	1	1.000	454000.0	454000.0	454000.0	ug/L
7704349	Sulfur	1	1	1.000	1780.0	1780.0	1780.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------- Site=Production , Location=Endpoint , Phase=Liquid , Extract=Direct -------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	21	21	1.000	0.1	0.7	12.0	mg/L
1-002	Biochemical Oxygen Demand	21	20	1.000	<DL	162.1	8400.0	mg/L
1-003	Chloride	21	21	1.000	5.0	9642.9	82000.0	mg/L
1-004	Chemical Oxygen Demand	21	21	1.000	330.0	1583.1	16600.0	mg/L
1-005	Nitrate/nitrite	21	15	0.994	<DL	3.1	8.2	mg/L
1-006	Hydrogen ion	21	21	1.000	2.7	7.6	8.1	pH
1-007	Oil and grease	21	21	1.000	11.0	50.8	4700.0	mg/L
1-009	Residue, non-filterable	21	21	1.000	18.0	89.2	6000.0	mg/L
1-010	Residue, filterable	21	21	1.000	968.0	21414.0	272000.0	mg/L
1-011	Specific conductivity	21	21	1.000	700.0	47573.0	525000.0	umho/cm
1-012	Total organic carbon	21	21	1.000	3.7	56.3	768.0	mg/L
1-013	Ignitability	21	21	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	21	21	1.000	2.7	7.6	8.1	pH
1-015	Reactivity	21	5	0.576	<DL	0.5	1.0	S(-/+)
1-017	Salinity (from chloride)	16	16	1.000	8.0	16665.8	140000.0	mg/L
1-018	Salinity (from sodium)	19	19	1.000	8.0	10658.5	280000.0	mg/L
65850	Benzoic acid	21	5	0.008	<DL	12.9	5022.2	ug/L
67641	2-Propanone	21	21	1.000	97.4	3114.3	399949.9	ug/L
71432	Benzene	21	16	0.925	<DL	447.4	3206.5	ug/L
75092	Methylene chloride	21	11	0.249	<DL	4289.3	383177.9	ug/L
75150	Carbon disulfide	21	1	0.148	<DL	6.4	43.4	ug/L
75274	Bromodichloromethane	21	1	0.000	<DL	0.0	12.9	ug/L
75694	Trichlorofluoromethane	21	1	0.000	<DL	0.0	26.4	ug/L
78591	Isophorone	21	3	0.248	<DL	2.4	17.5	ug/L
78933	2-Butanone	21	5	0.014	<DL	9.1	741.6	ug/L
79005	1,1,2-Trichloroethane	21	1	0.000	<DL	0.0	30.8	ug/L
84742	Di-n-butyl phthalate	21	1	0.000	<DL	0.0	41.7	ug/L
85018	Phenanthrene	21	5	0.076	<DL	12.1	1185.2	ug/L
86737	Fluorene	21	2	0.069	<DL	2.0	30.0	ug/L
91203	Naphthalene	21	16	0.846	<DL	65.1	420.3	ug/L
91576	2-Methylnaphthalene	21	12	0.836	<DL	29.1	186.4	ug/L
92524	Biphenyl	21	7	0.095	<DL	3.2	72.8	ug/L
95487	o-Cresol	21	11	0.415	<DL	23.9	378.5	ug/L
98555	alpha-Terpineol	21	1	0.455	<DL	5.6	12.4	ug/L
99876	p-Cymene	21	8	0.084	<DL	16.7	227.6	ug/L
100414	Ethylbenzene	21	10	0.071	<DL	9.6	318.2	ug/L
100425	Styrene	21	1	0.008	<DL	0.2	28.0	ug/L
105679	2,4-Dimethylphenol	21	11	0.457	<DL	110.0	1330.1	ug/L
106445	p-Cresol	21	9	0.414	<DL	62.2	1503.8	ug/L
108101	4-Methyl-2-pentanone	21	10	0.979	<DL	57.2	4422.2	ug/L
108883	Toluene	21	16	0.925	<DL	232.2	3519.7	ug/L
108907	Chlorobenzene	21	1	0.000	<DL	0.0	35.7	ug/L
108952	Phenol	21	10	0.622	<DL	71.4	6333.4	ug/L
108985	Benzenethiol	21	1	0.000	<DL	0.0	57.9	ug/L
110758	2-Chloroethylvinyl ether	21	1	0.000	<DL	0.2	3574.7	ug/L
112403	n-Dodecane	21	15	0.602	<DL	983.4	144720.9	ug/L
112958	n-Eicosane	21	11	0.777	<DL	181.6	21425.6	ug/L
117817	bis(2-Ethylhexyl) phthalate	21	15	0.979	<DL	133.3	2026.8	ug/L
121142	2,4-Dinitrotoluene	21	1	0.000	<DL	0.0	21.6	ug/L
124185	n-Decane	21	13	0.529	<DL	2794.7	464370.9	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------- Site=Production , Location=Endpoint , Phase=Liquid , Extract=Direct -------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
132649	Dibenzofuran	21	2	0.069	<DL	1.9	28.8	ug/L
132650	Dibenzothiophene	21	2	0.524	<DL	15.1	124.6	ug/L
142621	hexanoic acid	21	6	0.019	<DL	12.3	2005.9	ug/L
218019	Chrysene	21	2	0.006	<DL	0.0	11.8	ug/L
544763	n-Hexadecane	21	12	0.529	<DL	661.9	101850.0	ug/L
591786	2-Hexanone	21	1	0.011	<DL	0.3	28.8	ug/L
593453	n-Octadecane	21	11	0.598	<DL	349.3	47392.6	ug/L
615225	2-(methylthio)benzothiazole	21	3	0.395	<DL	12.8	41.3	ug/L
629594	n-Tetradecane	21	11	0.529	<DL	775.8	123586.9	ug/L
629970	n-Docosane	21	10	0.529	<DL	207.7	28211.3	ug/L
630013	n-Hexacosane	21	8	0.662	<DL	176.9	23948.4	ug/L
630024	n-Octacosane	21	7	0.514	<DL	92.2	10285.0	ug/L
638685	n-Triacontane	21	7	0.210	<DL	75.4	11593.8	ug/L
646311	n-Tetracosane	21	10	0.670	<DL	321.7	16976.5	ug/L
832699	1-Methylphenanthrene	21	3	0.075	<DL	24.6	2695.3	ug/L
1576676	3,6-Dimethylphenanthrene	21	1	0.006	<DL	0.8	137.1	ug/L
1730376	1-Methylfluorene	21	1	0.000	<DL	0.0	46.6	ug/L
7429905	Aluminum	24	6	0.291	<DL	111.9	1370.0	ug/L
7439895	Iron	24	23	0.931	<DL	2371.9	1720000.0	ug/L
7439921	Lead	24	4	0.007	<DL	2.0	519.0	ug/L
7439932	Lithium	24	16	0.640	<DL	2670.2	114000.0	ug/L
7439954	Magnesium	24	24	1.000	880.0	112673.0	6600000.0	ug/L
7439965	Manganese	24	23	0.958	<DL	236.6	152000.0	ug/L
7439976	Mercury	24	3	0.000	<DL	0.0	4.0	ug/L
7439987	Molybdenum	24	5	0.006	<DL	1.9	388.0	ug/L
7440020	Nickel	24	4	0.154	<DL	10.1	182.0	ug/L
7440097	Potassium	24	20	0.686	<DL	67830.6	3340000.0	ug/L
7440213	Silicon	24	22	0.990	<DL	23499.1	64000.0	ug/L
7440224	Silver	24	11	0.328	<DL	0.7	9.5	ug/L
7440235	Sodium	24	24	1.000	3340.0	4150656.9	80500000.0	ug/L
7440246	Strontium	24	23	1.000	<DL	18291.9	660000.0	ug/L
7440280	Thallium	24	2	0.148	<DL	4.1	53.0	ug/L
7440315	Tin	24	20	0.833	<DL	211.0	2020.0	ug/L
7440337	Tungsten	24	1	0.006	<DL	3.4	592.0	ug/L
7440360	Antimony	24	7	0.008	<DL	0.2	54.0	ug/L
7440382	Arsenic	24	9	0.689	<DL	268.3	8490.0	ug/L
7440393	Barium	24	21	0.930	<DL	17455.1	113000.0	ug/L
7440428	Boron	24	24	1.000	375.0	11881.8	249000.0	ug/L
7440439	Cadmium	24	7	0.229	<DL	2.7	105.0	ug/L
7440451	Cerium	24	6	0.678	<DL	264.5	1160.0	ug/L
7440473	Chromium	24	6	0.163	<DL	10.0	170.0	ug/L
7440484	Cobalt	24	2	0.000	<DL	0.0	120.0	ug/L
7440508	Copper	24	1	0.006	<DL	0.2	35.0	ug/L
7440666	Zinc	24	24	1.000	28.0	53.6	2440.0	ug/L
7440702	Calcium	24	24	1.000	1900.0	515234.4	25500000.0	ug/L
7553562	Iodine	24	3	0.153	<DL	154.3	1210.0	ug/L
7664417	Ammonia	21	19	0.988	<DL	7.4	830.0	mg/L
7704349	Sulfur	24	21	0.994	<DL	373592.5	696000.0	ug/L
7723140	Phosphorus (black, white, red, yell	24	7	0.014	<DL	15.8	1840.0	ug/L
7782492	Selenium	24	1	0.000	<DL	0.0	241.0	ug/L

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Production , Location=Endpoint , Phase=Liquid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
16984488	Fluoride	21	21	1.000	0.3	1.9	12.0	mg/L
18496258	Sulfide	21	2	0.112	<DL	13.9	200.0	mg/L

------------------------------ Site=Production , Location=Midpoint , Phase=Liquid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	3	3	1.000	0.1	0.6	0.9	mg/L
1-002	Biochemical Oxygen Demand	3	3	1.000	16.0	37.3	90.0	mg/L
1-003	Chloride	3	3	1.000	1100.0	24767.4	28000.0	mg/L
1-004	Chemical Oxygen Demand	3	3	1.000	110.0	1619.6	3390.0	mg/L
1-005	Nitrate/nitrite	3	3	1.000	1.0	214.1	390.0	mg/L
1-006	Hydrogen ion	3	3	1.000	6.4	6.6	8.0	pH
1-007	Oil and grease	3	3	1.000	41.0	818.0	7400.0	mg/L
1-009	Residue, non-filterable	3	3	1.000	92.0	5793.5	15500.0	mg/L
1-010	Residue, filterable	3	3	1.000	2190.0	47162.9	71000.0	mg/L
1-011	Specific conductivity	2	2	1.000	67500.0	96470.3	140000.0	umho/cm
1-012	Total organic carbon	3	3	1.000	4.0	36.1	346.0	mg/L
1-013	Ignitability	3	3	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	3	3	1.000	6.4	6.6	8.0	pH
1-017	Salinity (from chloride)	2	2	1.000	43000.0	44801.2	46000.0	mg/L
1-018	Salinity (from sodium)	2	2	1.000	32000.0	43588.1	61000.0	mg/L
67641	2-Propanone	5	2	0.373	<DL	82.6	228.7	ug/L
71432	Benzene	5	3	0.465	<DL	361.2	5820.0	ug/L
75092	Methylene chloride	5	2	0.373	<DL	66.8	3503.8	ug/L
75343	1,1-Dichloroethane	5	1	0.017	<DL	26.1	1540.2	ug/L
78933	2-Butanone	5	1	0.017	<DL	1.1	67.9	ug/L
85018	Phenanthrene	5	2	0.109	<DL	1.6	15.2	ug/L
86737	Fluorene	5	1	0.092	<DL	1.1	12.0	ug/L
91203	Naphthalene	5	4	0.644	<DL	45.1	294.9	ug/L
91576	2-Methylnaphthalene	5	4	0.644	<DL	29.7	143.7	ug/L
92524	Biphenyl	5	2	0.109	<DL	2.1	24.3	ug/L
95487	o-Cresol	5	3	0.552	<DL	44.9	423.4	ug/L
99876	p-Cymene	5	2	0.109	<DL	1.2	12.1	ug/L
100414	Ethylbenzene	5	1	0.017	<DL	3.4	202.3	ug/L
100425	Styrene	5	1	0.092	<DL	1.7	18.8	ug/L
105679	2,4-Dimethylphenol	5	4	0.644	<DL	86.5	819.1	ug/L
106445	p-Cresol	5	3	0.552	<DL	23.3	448.8	ug/L
108101	4-Methyl-2-pentanone	5	3	0.891	<DL	37.6	62.3	ug/L
108883	Toluene	5	4	0.732	<DL	360.9	4576.5	ug/L
108952	Phenol	5	3	0.552	<DL	24.7	1046.4	ug/L
112403	n-Dodecane	5	2	0.109	<DL	66.1	699.7	ug/L
112958	n-Eicosane	5	2	0.109	<DL	36.3	386.6	ug/L
117817	bis(2-Ethylhexyl) phthalate	5	4	0.732	<DL	16.6	39.0	ug/L
124185	n-Decane	5	2	0.109	<DL	45.8	493.6	ug/L
132650	Dibenzothiophene	5	1	0.017	<DL	0.1	11.6	ug/L
544763	n-Hexadecane	5	2	0.109	<DL	75.1	807.6	ug/L
593453	n-Octadecane	5	3	0.465	<DL	64.5	547.6	ug/L
629594	n-Tetradecane	5	2	0.109	<DL	53.8	571.4	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Production , Location=Midpoint , Phase=Liquid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
629970	n-Docosane	5	2	0.109	<DL	40.5	436.1	ug/L
630013	n-Hexacosane	5	2	0.109	<DL	23.7	252.7	ug/L
630024	n-Octacosane	5	2	0.109	<DL	10.4	109.6	ug/L
638686	n-Triacontane	5	2	0.109	<DL	24.9	266.4	ug/L
646311	n-Tetracosane	5	2	0.109	<DL	27.0	287.2	ug/L
7429905	Aluminum	3	2	0.638	<DL	38183.1	406000.0	ug/L
7439896	Iron	3	3	1.000	12300.0	52029.8	83100.0	ug/L
7439932	Lithium	3	2	0.907	<DL	5410.6	8840.0	ug/L
7439954	Magnesium	3	2	0.907	<DL	594104.6	839000.0	ug/L
7439965	Manganese	3	2	0.907	<DL	711.4	960.0	ug/L
7439987	Molybdenum	3	1	0.544	<DL	76.2	140.0	ug/L
7440097	Potassium	3	2	0.907	<DL	178449.4	272000.0	ug/L
7440213	Silicon	3	2	0.907	<DL	24110.2	35500.0	ug/L
7440224	Silver	3	2	0.907	<DL	3.9	6.0	ug/L
7440235	Sodium	3	3	1.000	1350000.0	15609333.6	23800000.0	ug/L
7440246	Strontium	3	2	0.907	<DL	27677.5	55200.0	ug/L
7440280	Thallium	3	1	0.362	<DL	10.1	28.0	ug/L
7440315	Tin	3	2	0.907	<DL	412.6	519.0	ug/L
7440382	Arsenic	3	1	0.362	<DL	113.7	314.0	ug/L
7440393	Barium	3	2	0.907	<DL	14943.4	37200.0	ug/L
7440428	Boron	3	3	1.000	5930.0	18071.5	27500.0	ug/L
7440439	Cadmium	3	1	0.362	<DL	4.3	12.0	ug/L
7440451	Cerium	3	1	0.362	<DL	121.3	335.0	ug/L
7440473	Chromium	3	2	0.907	<DL	48.0	53.0	ug/L
7440665	Zinc	3	3	1.000	23.0	267.3	2640.0	ug/L
7440702	Calcium	3	3	1.000	71900.0	1274489.4	1530000.0	ug/L
7553562	Iodine	3	1	0.544	<DL	849.3	1560.0	ug/L
7664417	Ammonia	3	3	1.000	0.2	47.6	160.0	mg/L
7704349	Sulfur	3	1	0.362	<DL	227.1	627.0	ug/L
16984488	Fluoride	3	2	0.907	<DL	1.5	2.4	mg/L

------------------------------ Site=Production , Location=Midpoint , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
91203	Naphthalene	1	1	1.000	145.7	145.7	145.7	ug/L
91576	2-Methylnaphthalene	1	1	1.000	37.9	37.9	37.9	ug/L
105679	2,4-Dimethylphenol	1	1	1.000	74.3	74.3	74.3	ug/L
7439954	Magnesium	1	1	1.000	9360.0	9360.0	9360.0	ug/L
7440235	Sodium	1	1	1.000	1370000.0	1370000.0	1370000.0	ug/L
7440393	Barium	1	1	1.000	1350.0	1350.0	1350.0	ug/L
7440428	Boron	1	1	1.000	3580.0	3580.0	3580.0	ug/L
7440666	Zinc	1	1	1.000	602.0	602.0	602.0	ug/L
7440702	Calcium	1	1	1.000	9140.0	9140.0	9140.0	ug/L
7704349	Sulfur	1	1	1.000	80300.0	80300.0	80300.0	ug/L

Table 15 (Cont'd)

Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of
Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Production , Location=Tank Bottom , Phase=Solid , Extract=Direct ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
1-001	Total volatile organic carbon	1	1	1.000	17.0	17.0	17.0	mg/kg
1-002	Biochemical Oxygen Demand	1	1	1.000	2930.0	2930.0	2930.0	mg/kg
1-003	Chloride	1	1	1.000	425.0	425.0	425.0	mg/kg
1-004	Chemical Oxygen Demand	1	1	1.000	7160.0	7160.0	7160.0	mg/kg
1-005	Nitrate/nitrite	1	1	1.000	716.0	716.0	716.0	mg/kg
1-006	Hydrogen ion	1	1	1.000	7.0	7.0	7.0	pH
1-007	Oil and grease	1	1	1.000	1000000.0	1000000.0	1000000.0	mg/kg
1-008	Residue, total	1	1	1.000	44.7	44.7	44.7	%
1-012	Total organic carbon	1	1	1.000	447000.0	447000.0	447000.0	mg/kg
1-013	Ignitability	1	1	1.000	200.0	200.0	200.0	degF
1-014	Corrosivity	1	1	1.000	7.0	7.0	7.0	pH
1-016	Oil and Grease (Retort)	1	1	1.000	519000.0	519000.0	519000.0	mg/kg
67641	2-Propanone	1	1	1.000	8178068.1	8178068.1	8178068.1	ug/kg
71432	Benzene	1	1	1.000	129340.9	129340.9	129340.9	ug/kg
78933	2-Butanone	1	1	1.000	1215363.6	1215363.6	1215363.6	ug/kg
85018	Phenanthrene	1	1	1.000	126887.5	126887.5	126887.5	ug/kg
100414	Ethylbenzene	1	1	1.000	34866.6	34866.6	34866.6	ug/kg
112403	n-Dodecane	1	1	1.000	1358206.2	1358206.2	1358206.2	ug/kg
112958	n-Eicosane	1	1	1.000	5715649.9	5715649.9	5715649.9	ug/kg
124185	n-Decane	1	1	1.000	371956.2	371956.2	371956.2	ug/kg
544763	n-Hexadecane	1	1	1.000	7598375.0	7598374.9	7598375.0	ug/kg
629594	n-Tetradecane	1	1	1.000	2168556.2	2168556.2	2168556.2	ug/kg
629970	n-Docosane	1	1	1.000	3790106.2	3790106.2	3790106.2	ug/kg
630013	n-Hexacosane	1	1	1.000	3041837.4	3041837.4	3041837.4	ug/kg
630024	n-Octacosane	1	1	1.000	2748387.4	2748387.4	2748387.4	ug/kg
638686	n-Triacontane	1	1	1.000	1027306.2	1027306.2	1027306.2	ug/kg
646311	n-Tetracosane	1	1	1.000	3270106.2	3270106.2	3270106.2	ug/kg
7429905	Aluminum	1	1	1.000	101.0	101.0	101.0	mg/kg
7439896	Iron	1	1	1.000	92200.0	92200.0	92200.0	mg/kg
7439954	Magnesium	1	1	1.000	537.0	537.0	537.0	mg/kg
7440020	Nickel	1	1	1.000	30.0	30.0	30.0	mg/kg
7440235	Sodium	1	1	1.000	5510.0	5510.0	5510.0	mg/kg
7440246	Strontium	1	1	1.000	2420.0	2420.0	2420.0	mg/kg
7440382	Arsenic	1	1	1.000	5.0	5.0	5.0	mg/kg
7440393	Barium	1	1	1.000	94.0	94.0	94.0	mg/kg
7440428	Boron	1	1	1.000	303.0	303.0	303.0	mg/kg
7440439	Cadmium	1	1	1.000	3.0	3.0	3.0	mg/kg
7440508	Copper	1	1	1.000	136.0	136.0	136.0	mg/kg
7440666	Zinc	1	1	1.000	128.0	128.0	128.0	mg/kg
7440702	Calcium	1	1	1.000	31700.0	31700.0	31700.0	mg/kg
7664417	Ammonia	1	1	1.000	140.0	140.0	140.0	mg/kg
7704349	Sulfur	1	1	1.000	92400.0	92400.0	92400.0	mg/kg
7723140	Phosphorus (black, white, red, yell	1	1	1.000	1160.0	1160.0	1160.0	mg/kg
16984488	Fluoride	1	1	1.000	140.0	140.0	140.0	mg/kg

Table 15 (Cont'd)
Summary Statistics for Field Sampling and Analysis Report
Exploration, Development, and Production of Crude Oil and Natural Gas
(Compounds detected in one or more samples only)

------------------------------ Site=Production , Location=Tank Bottom , Phase=Solid , Extract=TCLP ------------------------------

Cmpd#	Cmpd Name	N	Detected	Prop. Detect	Minimum	Wtd. Mean	Maximum	Units
67641	2-Propanone	1	1	1.000	1166.8	1166.8	1166.8	ug/L
71432	Benzene	1	1	1.000	1182.8	1182.8	1182.8	ug/L
75092	Methylene chloride	1	1	1.000	12.0	12.0	12.0	ug/L
75150	Carbon disulfide	1	1	1.000	20.9	20.9	20.9	ug/L
78933	2-Butanone	1	1	1.000	697.0	697.0	697.0	ug/L
83329	Acenaphthene	1	1	1.000	1404.3	1404.3	1404.3	ug/L
100414	Ethylbenzene	1	1	1.000	27.3	27.3	27.3	ug/L
108883	Toluene	1	1	1.000	59.7	59.7	59.7	ug/L
112403	n-Dodecane	1	1	1.000	[illegible]	14291.9	14291.9	ug/L
112958	n-Eicosane	1	1	[illegible]	[illegible]	23035.7	23035.7	ug/L
124185	n-Decane	1	1	[illegible]	[illegible]	7984.3	7984.3	ug/L
132649	Dibenzofuran	1	1	[illegible]	[illegible]	2310.7	2310.7	ug/L
544763	n-Hexadecane	1	1	[illegible]	[illegible]	108366.9	108366.9	ug/L
629594	n-Tetradecane	1	1	1.000	75125.5	75125.5	75125.5	ug/L
629970	n-Docosane	1	1	1.000	98990.1	98990.1	98990.1	ug/L
630013	n-Hexacosane	1	1	1.000	28640.3	28640.3	28640.3	ug/L
630024	n-Octacosane	1	1	1.000	70541.3	70541.3	70541.3	ug/L
638686	n-Triacontane	1	1	1.000	11003.0	11003.0	11003.0	ug/L
646311	n-Tetracosane	1	1	1.000	25487.9	25487.9	25487.9	ug/L
7439896	Iron	1	1	1.000	28900.0	28900.0	28900.0	ug/L
7439954	Magnesium	1	1	1.000	6710.0	6710.0	6710.0	ug/L
7439965	Manganese	1	1	1.000	674.0	674.0	674.0	ug/L
7440235	Sodium	1	1	1.000	1360000.0	1360000.0	1360000.0	ug/L
7440246	Strontium	1	1	1.000	22000.0	22000.0	22000.0	ug/L
7440393	Barium	1	1	1.000	733.0	733.0	733.0	ug/L
7440428	Boron	1	1	1.000	850.0	850.0	850.0	ug/L
7440666	Zinc	1	1	1.000	280.0	280.0	280.0	ug/L
7440702	Calcium	1	1	1.000	291000.0	291000.0	291000.0	ug/L
7704349	Sulfur	1	1	1.000	20100.0	20100.0	20100.0	ug/L
7723140	Phosphorus (black, white, red, yell	1	1	1.000	1890.0	1890.0	1890.0	ug/L

Site: A description of type of site sampled -
  Central treatment (centralized treatment facility)
  Central pit (centralized pit)
  Drilling
  Production

Location: A description of the point at which the sample was taken at the site -
  Influent
  Effluent
  Tank
  Central pit (commercial facility)
  Mid-point (of production)
  End-point (of production)
  Tank bottom
  Pit (drilling)
  Drilling mud

Phase: Refers to the physical state of the sample and in the case of pits is an indicator of whether the sample was a supernatant or sludge -
  Liquid (supernatant)
  Solid (sludge)

Extract: Refers to the analytical procedure used to characterize the waste. The samples were analyzed by either constituent analysis (direct) or the TCLP -
  Direct
  TCLP

Cmpd#: CAS compound number
Cmpd Name: Compound name

N: The number of samples analyzed for the compound
Detected: The number of samples in which the compound was detected
Prop. Detect.: Estimated population proportion of samples with detectable amount of compound, calculated as the volume-weighted proportion of detection, as the mean of a 0/1 indicator of compound detection in each sample
Minimum: The minimum concentration reported, or "<DL" if one or more samples had no detectable amount of the compound
Mean: The volume-weighted mean concentration
Maximum: The maximum concentration reported
Units: Concentration units
pH: Refers to the negative base ten logarithm of the hydrogen on concentration

volume for the site and combined between zones by following process, for each pollutant, site type, sampling location, and sample phase and extract (liquid, solid, or TCLP):

1. Analyses of multiple samples at the same sample point (if more than one were taken and analyzed) at the same site are averaged to produce

$$\overline{C}_p \quad ,$$

the estimated average concentration of the pollutant for the site.

2. Weighted mean concentrations for each zone are calculated as

$$\overline{C}_z = \frac{\Sigma \quad f_p \overline{C}_p}{\Sigma \quad f_p} \quad ,$$

where $\overline{C}_p$ are the average concentrations of the pollutant at each site, f_p are the associated waste volumes, and n_z is the number of sites randomly sampled in the zone. (The number of random samples analyzed per Zone differs for each analytical method.) This calculation is based on the assumption that each state in a zone has the same average total production as other sites in the same zone, and hence that the weighted selection of state, followed by an random selection of sites based on the list from each state, leads to an equal chance of selecting each site within the zone as a random sample site.

If other estimates of the total number of sites in a state and zone were available, an appropriate adjustment to the weighting would be used by the ratio of the actual (or more accurately estimated) number of sites in a state and zone to the original probabilities used to select the states.

3. Zone estimates based on random samples are combined with the directed samples based on the total zone waste volume and the total volume at the directed sites by

$$\overline{C}'_z = [(F_z - \Sigma \; f_d) \overline{C}_z + (\Sigma \; f_d \overline{C}_d)]/F_z$$

where F_z are the total zone waste volumes (independently estimated, as described below), and f_d and C_d are the waste volume and average concentration at each directed site in the zone.

4. National estimates are produced by weighting by the zone volumes

$$\overline{C} = \frac{\Sigma \; F_z \, \overline{C}'_z}{\Sigma \; F_z} \quad .$$

Waste Volumes

The waste volume corresponding to water measurements at production sites is the produced water volume. Produced water volume was reported for each site in barrels of produced water per day. The waste volumes applicable to liquid and solid pit samples are the total liquid and solid waste, respectively, generated by the site during the course of drilling.

The drilling waste volumes associated with each site were calculated based on engineering inspection and information from site operators, based on the current volumes in the pit at time of visit, the amounts of previously removed material from the pit, and the percentage of drilling completed. As no appropriate measure of waste volume was available for other site types (central pit, central treatment), and those sites were all directed sites, a simple arithmetic mean of the reported concentrations is calculated for those sites.

The zone and national total waste volume amounts were estimated from independent information sources. Produced water volumes and total drilling waste volumes by state were estimated for the five years 1981-1985. The five-year average waste volume for each state was totalled to form the total zone average waste volume used in the calculation of the national concentration estimates.

In cases where other estimates of produced water calculations were not available, produced water values were estimated from the oil production values for the state for that year, by multiplying by (1) the average ratio of produced water to oil production for other years at the same state, if available, or (2) by the average ratio of produced water to oil production for all years and states in the same zone where data was available.

Total drilling waste values for each state were computed as the sum of the five-year average drilling waste estimates for each state. The proportion of liquid and solid drilling waste was estimated for each zone based on the (volume-weighted) average proportion of liquid and solid waste observed at the sites visited in the zone. This proportion was applied to the total drilling waste value to produce estimated zone liquid and solid drilling waste values for use in the concentration weighting.

Detection Limits

In computing summary statistics, those samples with concentrations reported less than the detection limit must be accounted for. A number of different statistical approaches are possible to the handling of detection limit values in calculating summary statistics. For purposes of calculating summary statistics in this report, samples which showed no detectable level of a compound were assigned the concentration value of zero. Statistics produced by this method give conservative lower bounds to the effect of the detection limit samples. Further analysis of ways to most appropriately account for the detection limit samples may be of interest in further work with these data.

Statements of Data Quality for Samples

Statements of data quality (Data Quality Indicators) were generated by computing the mean and variability of the recovery of the analytes spiked into samples for the conventional pollutants, and of stable isotopically labeled analogs of the pollutants spiked into samples for organic compounds. These are reported in the "Statements of Data Quality (Data Quality Indicators) for Samples" in Table 16.

Statements were not produced for metals because EPA did not require the laboratory to report all quality assurance results. EPA has requested these data and has received a portion of them, but did not have time to include them in this report. EPA will include these data in the record that will support the Report to Congress.

Labeled compound recoveries for the organic analytes include every incidence of detection, regardless of level of dilution, but do not include "not detects" because of the time needed to

Table 16
Statement of Data Quality (Data Quality Indicators) for Samples

-- Phase =Liquid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
50293	4,4'-DDT	2	28.5	2.1	9.4	47.6
55389	Phosphorodithioic acid, O,O-dimethyl-, O	2	68.5	2.1	49.4	87.6
56382	Phosphorothioic acid, O,O-diethyl O-(4-n	2	84.0	4.2	45.9	122.1
58899	Cyclohexane, 1,2,3,4,5,6-hexachloro-,	2	75.0	2.8	49.6	100.4
60571	Dieldrin	2	0.0	0.0	0.0	0.0
72208	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10	2	43.5	2.1	24.4	62.6
76448	Heptachlor	2	33.5	2.1	14.4	52.6
93765	2,4,5-Trichlorophenoxyacetic acid	2	14.0	1.4	1.3	26.7
94757	2,4-Dichlorophenoxyacetic acid, salts an	2	84.0	28.3	0.0	338.1
EGD184	37Cl-tetrachlorodibenzo-p-dioxins	1	106.5	.	.	.
EGD191	13C12-pentachlorodibenzo-p-dioxins	1	44.5	.	.	.
EGD192	13C12-hexachlorodibenzo-p-dioxins	1	59.0	.	.	.
EGD193	13C12-tetrachlorodibenzofurans	1	34.0	.	.	.
EGD194	13C12-hexachlorodibenzofurans	1	109.0	.	.	.
EGD429	13C12-2378-tetrachlorodibenzo-p-dioxin	1	23.0	.	.	.
121755	Succinic acid, mercapto-, diethyl ester,	2	75.0	1.4	62.3	87.7
309002	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10	2	13.0	0.0	13.0	13.0
666524	acetone-d6	44	111.1	64.6	91.5	130.8
786196	Phosphorodithioic acid, s(((p-chlorophen	2	54.0	5.7	3.2	104.8
1076433	benzene-d6	71	98.1	9.3	95.9	100.3
1111882	bromomethane-d3	71	99.8	25.8	93.7	105.9
1111893	chloromethane-d3	71	118.1	58.2	104.4	131.9
1146652	naphthalene-d8	77	76.0	25.0	70.4	81.7
1486017	biphenyl-d10	76	63.6	20.4	58.9	68.2
1517222	phenanthrene-d10	76	84.6	28.1	78.2	91.0
1665005	methylene chloride-d2	71	381.6	1081.2	125.7	637.5
1718521	pyrene-d10	76	95.1	33.6	87.4	102.8
1718532	benzo(a)anthracene-d12	77	95.0	38.8	86.2	103.8
1719035	chrysene-d12	77	99.4	39.3	90.4	108.3
1719068	anthracene-d10	76	94.6	36.0	86.4	102.8
2037265	toluene-d8	71	106.6	27.0	100.2	113.0
2199691	1,2-dichlorobenzene-d4	77	57.4	22.7	52.2	62.5
2199704	1,3-dichlorobenzene-d4	77	55.2	23.5	49.8	60.5
2199726	1,2,4-trichlorobenzene-d3	76	63.5	24.2	58.0	69.1
2679892	diethyl ether-d10	71	100.4	19.3	95.8	105.0
2747582	1,1,1-trichloroethane-d3	71	99.1	16.1	95.3	102.9
2921882	Phosphorodithioic acid, O,O-diethyl	2	43.0	2.8	17.6	68.4
3114554	chlorobenzene-d5	71	105.6	22.2	100.3	110.8
3855821	1,4-dichlorobenzene-d4	77	58.2	24.3	52.7	63.7
4165600	nitrobenzene-d5	77	68.5	23.0	63.3	73.7
4165622	phenol-d5	74	65.9	91.9	44.6	87.2
5161295	styrene-d5	77	51.1	22.2	46.1	56.2
6745353	vinyl chloride-d3	71	95.2	31.2	87.8	102.6
15067202	acenaphthene-d10	76	79.4	23.6	74.1	84.8
15716082	n-C16-d34	75	79.1	26.1	73.1	85.1
16416298	n-C10-d22	77	35.8	22.9	30.5	41.0
16416301	n-C12-d26	76	59.2	23.1	54.0	64.5
16416323	n-C24-d50	77	97.6	34.9	89.7	105.5
17070070	1,2-dichloroethane-d4	71	94.8	14.0	91.5	98.2
19199918	chloroethane-d5	71	87.5	26.9	81.1	93.8
22280735	1,1-dichloroethane-d2	71	88.6	21.1	83.6	93.6

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators)
for Samples

--- Phase =Liquid , Extract =Direct ---

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
25837052	ethylbenzene-d10	71	102.6	25.8	96.5	108.7
31717449	chloroform-13C	71	91.8	10.2	89.4	94.2
32488496	tetrachlorethene-13C2	71	63.3	22.2	58.0	68.5
32488509	carbon tetrachloride-13C	71	88.6	23.9	83.0	94.3
33262292	dibenzothiophene-d8	75	95.1	45.8	84.5	105.6
33685540	1,1,2,2-tetrachloroethane-d2	71	94.0	19.8	89.3	98.7
33984053	acrolein-d4	36	113.6	63.0	92.3	135.0
37055519	diphenylamine-d10	74	86.1	24.3	80.5	91.8
42366472	trans-1,2-dichlorethene-d3	71	89.0	13.1	85.9	92.1
53389267	methyl ethyl ketone-d3	1	16.1	.	.	.
53807264	acrylonitrile-d3	71	72.6	67.0	56.7	88.4
56912777	1,1-dichloroethane-d3	71	90.8	10.7	88.3	93.3
62369679	n-C20-d42	77	91.2	32.3	83.9	98.5
63466717	benzo(a)pyrene-d12	77	88.5	41.0	79.2	97.8
72802814	bromoform-13C	68	106.2	107.9	80.1	132.3
81103799	fluorene-d10	75	86.0	31.2	78.8	93.2
85380741	pentachlorophenol-13C6	66	54.2	30.1	46.8	61.6
92890636	benzidine-d8	44	47.2	36.0	36.2	58.1
93951667	benzo(ghi)perylene-d12	76	78.9	51.0	67.3	90.6
93951678	bis(2-chloroisopropyl) ether-d12	77	71.0	19.2	66.6	75.3
93951689	2,4-dinitrotoluene-d3	73	75.2	30.1	68.2	82.3
93951690	fluoranthene-d10	76	92.8	29.8	85.9	99.6
93951703	hexachlorobutadiene-13C4	77	61.3	26.0	55.4	67.2
93951725	4-chloro-3-methylphenol-d2	68	51.8	28.0	45.0	58.6
93951736	2-chlorophenol-d4	72	61.8	20.0	57.1	66.5
93951747	2,4-dichlorophenol-d3	72	58.2	20.1	53.5	62.9
93951751	2-nitrophenol-d4	70	59.2	24.4	53.4	65.0
93951758	2,4-dimethylphenol-d3	89	43.1	25.0	37.8	48.3
93951769	2-methyl-4,6-dinitrophenol-d2	64	54.1	31.2	46.3	61.9
93951770	2,4-dinitrophenol-d3	39	52.8	34.4	41.7	64.0
93951792	4-nitrophenol-d4	40	67.0	36.0	55.5	78.5
93951805	2,4,6-trichlorophenol-d2	73	49.2	18.0	45.0	53.4
93951849	2-chloronaphthalene-d7	76	79.8	24.8	74.1	85.5
93951850	4-chlorophenyl phenyl ether-d5	76	78.8	28.3	72.4	85.3
93951861	trans-1,3-dichloropropene-d4	70	81.8	9.7	79.5	84.2
93951872	bis(2-ethylhexyl) phthalate-d4	77	99.3	33.7	91.7	107.0
93951894	dimethyl phthalate-d4	75	48.4	28.4	41.8	54.9
93951907	2,6-dinitrotoluene-d3	75	99.6	46.6	88.9	110.3
93951918	3,3'-dichlorobenzidine-d6	73	74.8	37.9	66.0	83.7
93951929	1,2-diphenylhydrazine-d10	75	87.0	29.8	80.1	93.8
93951930	alpha-picoline-d7	74	68.1	22.6	62.9	73.4
93951941	beta-naphthylamine-d7	63	75.6	34.7	66.8	84.3
93951952	N-nitrosodiphenylamine-d6	74	86.2	24.0	80.7	91.8
93951974	acenaphthylene-d8	76	71.6	21.1	66.8	76.4
93951985	benzo(b)fluoranthene-d12	77	95.2	46.6	84.6	105.8
93951996	dibromochloromethane-13C	71	89.5	15.6	85.8	93.2
93952002	trichloroethene-13C2	71	72.5	11.6	69.7	75.2
93952013	benzo(k)fluoranthene-d12	77	92.9	38.8	84.1	101.7
93952024	bis(2-chloroethyl) ether-d8	77	71.2	19.7	66.8	75.7
93952035	p-cymene-d14	77	58.9	26.8	52.8	64.9
93952046	dibenzofuran-d8	75	81.9	25.9	76.0	87.9

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Samples

Phase =Liquid , Extract =Direct

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
93952057	diphenyl ether-d10	76	76.6	25.2	70.9	82.4
93952068	alpha-terpinnol-d3	25	70.5	29.0	58.6	82.5
93952079	n-C30-d62	77	89.8	37.5	81.3	98.3
93952080	1,2-dichloropropane-d6	71	98.8	7.3	97.0	100.5
93952091	1,1,2-trichloroethane-13C2	71	103.6	11.6	100.8	106.3
93952104	bromodichloromethane-13C	71	91.8	9.4	89.6	94.1
93952115	di-n-butyl phthalate-d4	77	96.2	30.7	89.2	103.2
93952126	diethyl phthalate-d4	75	68.1	34.4	60.2	76.0
93952137	di-n-octyl phthalate-d4	77	102.4	41.1	93.1	111.7
93952148	hexachlorobenzene-13C6	77	84.4	31.1	77.3	91.4
93952159	hexachloroethane-13C	77	52.5	28.9	45.9	59.0
93952160	isophorone-d8	76	72.3	19.9	67.8	76.9
1-003	Chloride	3	103.7	1.5	99.9	107.5
1-005	Nitrate/nitrite	3	105.3	2.3	99.6	111.1
1-012	Total organic carbon	1	111.0	.	.	.
57125	Cyanides (soluble salts and complexes) N	1	90.0	.	0.0	.
16984488	Fluoride	2	97.5	7.8	27.6	167.4
18496258	Sulfide	1	102.0	.	.	.

Phase =Solid , Extract =Direct

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
50293	4,4'-DDT	2	86.0	2.8	60.6	111.4
55389	Phosphorodithioic acid, O,O-dimethyl-, O	2	95.5	3.5	63.7	127.3
56382	Phosphorothioic acid, O,O-diethyl O-(4-n	2	106.5	3.5	74.7	138.3
58899	Cyclohexane, 1,2,3,4,5,6-hexachloro-,	2	101.0	18.4	0.0	266.2
60571	Dieldrin	2	0.0	0.0	0.0	0.0
72208	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10	2	97.0	1.4	84.3	109.7
76448	Heptachlor	2	87.5	2.1	68.4	106.6
93765	2,4,5-Trichlorophenoxyacetic acid	2	88.0	22.6	0.0	291.3
94757	2,4-Dichlorophenoxyacetic acid, salts an	2	33.0	2.8	7.6	58.4
EGD184	37Cl-tetrachlorodibenzo-p-dioxins	14	106.7	13.6	98.8	114.5
EGD191	13C12-pentachlorodibenzo-p-dioxins	10	65.5	22.4	49.5	81.5
EGD192	13C12-hexachlorodibenzo-p-dioxins	10	65.9	26.6	46.9	84.9
EGD193	13C12-tetrachlorodibenzofurans	14	64.7	28.4	48.3	81.1
EGD194	13C12-hexachlorodibenzofurans	10	94.1	40.5	65.1	123.0
EGD429	13C12-2378-tetrachlorodibenzo-p-dioxin	14	70.2	27.4	54.4	86.0
121755	Succinic acid, mercapto-, diethyl ester,	2	101.0	2.8	75.6	126.4
309002	1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10	2	39.0	1.4	26.3	51.7
666524	acetone-d6	30	90.0	41.3	74.6	105.4
786196	Phosphorodithioic acid, s(((p-chlorophen	2	77.5	2.1	58.4	96.6
1076433	benzene-d6	41	108.3	14.9	103.6	113.0
1111882	bromomethane-d3	41	101.0	37.3	89.2	112.7
1111893	chloromethane-d3	41	158.8	68.9	137.0	180.5
1146652	naphthalene-d8	35	70.4	28.3	60.7	80.2
1486017	biphenyl-d10	34	56.4	24.0	48.0	64.8
1517222	phenanthrene-d10	34	73.5	30.5	62.8	84.1
1665005	methylene chloride-d2	41	59.6	27.0	51.0	68.1

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Samples

-- Phase =Solid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
1718521	pyrene-d10	35	84.9	33.0	73.6	96.2
1718532	benzo(a)anthracane-d12	35	91.1	42.0	76.7	105.6
1719035	chrysene-d12	35	90.7	38.0	77.7	103.8
1719068	anthracene-d10	34	86.1	36.2	73.5	98.7
2037265	toluene-d8	40	156.9	82.1	130.7	183.2
2199691	1,2-dichlorobenzene-d4	34	57.3	25.3	48.5	66.2
2199704	1,3-dichlorobenzene-d4	34	55.2	25.3	46.4	64.1
2199726	1,2,4-trichlorobenzene-d3	35	58.0	24.7	49.5	66.5
2679892	diethyl ether-d10	41	93.6	11.0	90.1	97.0
2747582	1,1,1-trichloroethane-d3	41	108.8	19.4	102.7	115.0
2921882	Phosphorodithioic acid, O,O-diethyl	2	55.0	2.8	29.6	80.4
3114554	chlorobenzene-d5	39	144.4	68.7	122.1	166.7
3855821	1,4-dichlorobenzene-d4	34	57.5	25.8	48.5	66.5
4165600	nitrobenzene-d5	35	66.2	26.5	57.1	75.4
4165622	phenol-d5	33	41.9	26.0	32.7	51.2
5161295	styrene-d5	35	51.2	26.3	42.2	60.2
6745353	vinyl chloride-d3	41	111.7	43.2	98.0	125.3
15067202	acenaphthene-d10	33	73.2	27.6	63.5	83.0
15716082	n-C16-d34	35	73.4	30.3	63.0	83.8
16416298	n-C10-d22	34	33.9	17.7	27.7	40.0
16416301	n-C12-d26	35	57.3	26.9	48.0	66.5
16416323	n-C24-d50	35	94.5	42.2	80.1	109.0
17070070	1,2-dichloroethane-d4	41	98.3	14.1	93.9	102.8
19199918	chloroethane-d5	41	91.0	38.6	78.8	103.2
22280735	1,1-dichloroethane-d2	41	101.7	14.7	97.0	106.3
25837052	ethylbenzene-d10	40	140.3	76.9	115.7	164.9
31717449	chloroform-13C	41	97.8	10.6	94.4	101.1
32428496	tetrachlorethene-13C2	39	91.1	45.5	76.3	105.8
32488509	carbon tetrachloride-13C	41	112.4	32.0	102.3	122.5
33262292	dibenzothiophene-d8	35	87.9	44.6	72.6	103.3
33685540	1,1,2,2-tetrachloroethane-d2	40	133.5	98.4	102.0	164.9
33984053	acrolein-d4	30	73.0	32.4	60.9	85.1
37055519	diphenylamine-d10	33	81.4	27.2	71.8	91.0
42366472	trans-1,2-dichlorethene-d3	41	88.4	20.3	82.0	94.8
53807264	acrylonitrile-d3	41	79.5	44.6	65.5	93.6
56912777	1,1-dichloroethane-d3	41	97.7	11.7	94.0	101.3
62369679	n-C20-d42	35	85.1	32.7	73.9	96.4
63466717	benzo(a)pyrene-d12	34	96.3	55.9	76.8	115.9
72802814	bromoform-13C	35	76.1	33.6	64.6	87.7
81103799	fluorene-d10	33	77.3	33.2	65.6	89.1
85380741	pentachlorophenol-13C6	20	38.2	31.6	23.4	53.0
92890636	benzidine-d8	16	64.0	58.0	33.1	94.9
93951667	benzo(ghi)perylene-d12	34	84.3	62.3	62.6	106.1
93951678	bis(2-chloroisopropyl) ether-d12	35	68.0	26.6	58.8	77.2
93951689	2,4-dinitrotoluene-d3	33	80.0	29.2	69.6	90.3
93951690	fluoranthene-d10	35	82.6	32.3	71.6	93.7
93951703	hexachlorobutadiene-13C4	34	54.7	27.3	45.1	64.2
93951725	4-chloro-3-methylphenol-d2	33	48.9	24.8	40.1	57.7
93951736	2-chlorophenol-d4	33	51.6	18.1	45.2	58.0
93951747	2,4-dichlorophenol-d3	33	49.1	20.6	41.8	56.4
93951751	2-nitrophenol-d4	33	45.7	20.3	38.5	52.9

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Samples

Phase =Solid , Extract =Direct

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
93951758	2,4-dimethylphenol-d3	43	41.0	28.0	32.4	49.7
93951769	2-methyl-4,6-dinitrophenol-d2	24	38.5	26.4	27.3	49.6
93951770	2,4-dinitrophenol-d3	9	45.2	32.3	20.4	70.0
93951792	4-nitrophenol-d4	16	48.6	29.6	32.8	64.3
93951805	2,4,6-trichlorophenol-d2	33	41.7	14.6	36.5	46.8
93951849	2-chloronaphthalene-d7	34	70.8	31.9	59.6	81.9
93951850	4-chlorophenyl phenyl ether-d5	35	70.1	29.2	60.1	80.2
93951861	trans-1,3-dichloropropene-d4	41	79.7	10.1	76.6	82.9
93951872	bis(2-ethylhexyl) phthalate-d4	35	97.1	41.3	83.0	111.3
93951894	dimethyl phthalate-d4	33	54.5	24.5	45.8	63.2
93951907	2,6-dinitrotoluene-d3	33	110.6	57.7	90.2	131.1
93951918	3,3'-dichlorobenzidine-d6	34	78.7	39.3	65.0	92.4
93951929	1,2-diphenylhydrazine-d10	34	82.4	32.7	71.0	93.8
93951930	alpha-picoline-d7	35	61.5	33.8	49.9	73.1
93951941	beta-naphthylamine-d7	29	66.5	50.4	47.3	85.7
93951952	N-nitrosodiphenylamine-d6	33	75.9	26.7	66.4	85.3
93951974	acenaphthylene-d8	33	68.5	25.3	59.5	77.4
93951985	benzo(b)fluoranthene-d12	35	93.6	51.7	75.8	111.3
93951996	dibromochloromethane-13C	41	87.3	16.3	82.1	92.4
93952002	trichloroethene-13C2	41	77.8	10.7	74.4	81.2
93952013	benzo(k)fluoranthene-d12	35	93.0	48.1	76.5	109.5
93952024	bis(2-chloroethyl) ether-d8	35	64.0	29.9	53.7	74.2
93952035	p-cymene-d14	35	57.3	26.9	48.0	66.5
93952046	dibenzofuran-d8	33	74.8	29.3	64.4	85.2
93952057	diphenyl ether-d10	34	70.8	27.3	61.3	80.3
93952068	alpha-terpineol-d3	15	77.3	45.6	52.0	102.5
93952079	n-C30-d62	35	95.7	51.3	78.1	113.3
93952080	1,2-dichloropropane-d6	41	105.8	12.8	101.7	109.8
93952091	1,1,2-trichloroethane-13C2	41	119.4	37.2	107.6	131.1
93952104	bromodichloromethane-13C	41	103.2	13.8	98.9	107.6
93952115	di-n-butyl phthalate-d4	35	89.3	36.8	76.6	101.9
93952126	diethyl phthalate-d4	34	70.3	32.1	59.1	81.5
93952137	di-n-octyl phthalate-d4	35	103.4	49.9	86.2	120.5
93952148	hexachlorobenzene-13C6	35	76.0	31.3	65.2	86.8
93952159	hexachloroethane-13C	35	49.3	25.1	40.6	57.9
93952160	isophorone-d8	35	72.3	26.0	63.4	81.2
1-012	Total organic carbon	3	99.3	3.8	89.9	108.7
57125	Cyanides (soluble salts and complexes) N	1	92.0	.	0.0	.

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Samples

-- Phase =Solid , Extract =TCLP --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
666524	acetone-d6	24	96.2	71.4	66.1	126.4
1076433	benzene-d6	27	96.2	13.0	91.0	101.3
1111882	bromomethane-d3	27	88.6	45.2	70.7	106.5
1111893	chloromethane-d3	27	130.0	89.7	94.5	165.5
1146652	naphthalene-d8	25	78.2	16.9	71.3	85.2
1486017	biphenyl-d10	25	65.4	11.8	60.5	70.3
1517222	phenanthrene-d10	25	88.0	19.5	79.9	96.0
1665005	methylene chloride-d2	27	207.2	757.4	0.0	506.8
1718521	pyrene-d10	25	96.8	25.9	86.1	107.5
1718532	benzo(a)anthracene-d12	25	88.1	60.8	63.0	113.1
1719035	chrysene-d12	25	102.2	45.6	83.4	121.0
1719068	anthracene-d10	25	102.1	16.7	95.2	109.0
2037265	toluene-d8	27	107.3	25.7	97.2	117.5
2199691	1,2-dichlorobenzene-d4	25	57.3	16.8	50.4	64.2
2199704	1,3-dichlorobenzene-d4	25	56.8	18.2	49.2	64.3
2199726	1,2,4-trichlorobenzene-d3	24	66.3	15.9	59.5	73.0
2679892	diethyl ether-d10	27	98.6	29.9	86.8	110.5
2747582	1,1,1-trichloroethane-d3	27	97.9	35.8	83.7	112.1
3114554	chlorobenzene-d5	27	115.0	29.4	103.4	126.6
3855821	1,4-dichlorobenzene-d4	25	59.4	18.2	51.9	66.9
4165600	nitrobenzene-d5	25	64.4	16.6	57.6	71.3
4165622	phenol-d5	14	49.9	33.6	30.5	69.3
5161295	styrene-d5	25	51.9	17.0	44.9	58.9
6745353	vinyl chloride-d3	27	100.9	68.7	73.7	128.0
15067202	acenaphthene-d10	25	82.8	17.4	75.6	90.0
15716082	n-C16-d34	25	79.8	16.2	73.1	86.5
16416298	n-C10-d22	25	29.1	11.6	24.3	33.9
16416301	n-C12-d26	25	56.1	16.4	49.4	62.9
16416323	n-C24-d50	25	103.5	44.7	85.0	121.9
17070070	1,2-dichloroethane-d4	27	97.0	42.2	80.3	113.7
19199918	chloroethane-d5	27	78.5	37.7	63.6	93.4
22280735	1,1-dichloroethene-d2	27	87.8	34.4	74.2	101.4
25837052	ethylbenzene-d10	27	109.1	24.4	99.4	118.8
31717449	chloroform-13C	27	90.7	30.0	78.8	102.6
32488496	tetrachlorethane-13C2	27	73.4	24.0	64.0	82.9
32488509	carbon tetrachloride-13C	27	101.4	42.3	84.7	118.1
33262292	dibenzothiophene-d8	25	94.7	14.0	88.9	100.5
33685540	1,1,2,2-tetrachloroethane-d2	27	93.1	25.5	83.0	103.2
33984053	acrolein-d4	14	102.1	109.9	38.6	165.5
37055519	diphenylamine-d10	25	89.1	15.2	82.8	95.4
42366472	trans-1,2-dichlorethene-d3	27	88.4	44.9	70.6	106.1
53807264	acrylonitrile-d3	27	98.7	92.1	62.2	135.1
56912777	1,1-dichloroethane-d3	27	90.3	33.2	77.2	103.5
62369679	n-C20-d42	25	94.0	17.9	86.6	101.5
63466717	benzo(a)pyrene-d12	25	80.9	52.8	59.1	102.7
72802814	bromoform-13C	27	108.9	70.8	80.9	136.9
81103799	fluorene-d10	25	85.9	17.9	78.5	93.2
85380741	pentachlorophenol-13C6	12	32.8	31.1	13.1	52.6
92890636	benzidine-d8	10	30.4	45.5	0.0	62.9
93951667	benzo(ghi)perylene-d12	25	74.7	60.9	49.8	99.6
93951678	bis(2-chloroisopropyl) ether-d12	25	71.6	15.3	65.3	78.1

Table 16 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Samples

-- Phase =Solid , Extract =TCLP --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
93951689	2,4-dinitrotoluene-d3	24	79.7	15.8	73.0	86.4
93951690	fluoranthene-d10	25	92.6	14.5	86.6	98.6
93951703	hexachlorobutadiene-13C4	25	65.2	17.1	58.1	72.3
93951725	4-chloro-3-methylphenol-d2	15	45.9	20.7	34.4	57.3
93951736	2-chlorophenol-d4	16	53.9	21.0	42.7	65.1
93951747	2,4-dichlorophenol-d3	15	48.0	23.2	35.2	60.9
93951751	2-nitrophenol-d4	16	60.5	24.3	47.6	73.4
93951758	2,4-dimethylphenol-d3	26	27.7	21.4	19.1	36.3
93951769	2-methyl-4,6-dinitrophenol-d2	14	44.2	29.2	27.4	61.1
93951770	2,4-dinitrophenol-d3	6	53.0	34.3	17.0	89.0
93951792	4-nitrophenol-d4	7	40.7	19.5	22.8	58.7
93951805	2,4,6-trichlorophenol-d2	15	45.0	16.7	35.8	54.3
93951849	2-chloronaphthalene-d7	25	81.0	15.4	74.7	87.4
93951850	4-chlorophenyl phenyl ether-d5	25	83.2	14.5	77.2	89.2
93951861	trans-1,3-dichloropropene-d4	26	77.2	19.5	69.3	85.1
93951872	bis(2-ethylhexyl) phthalate-d4	25	101.0	44.0	82.8	119.2
93951894	dimethyl phthalate-d4	25	35.9	14.7	29.8	41.9
93951907	2,6-dinitrotoluene-d3	25	106.0	24.3	96.0	116.1
93951918	3,3'-dichlorobenzidine-d6	25	72.2	68.6	43.9	100.6
93951929	1,2-diphenylhydrazine-d10	25	90.8	15.2	84.5	97.0
93951930	alpha-picoline-d7	23	67.6	18.3	59.7	75.5
93951941	beta-naphthylamine-d7	23	66.8	29.1	54.2	79.4
93951952	N-nitrosodiphenylamine-d6	25	88.5	14.5	82.5	94.5
93951974	acenaphthylene-d8	25	77.7	20.6	69.2	86.2
93951985	benzo(b)fluoranthene-d12	25	85.6	66.1	58.3	112.8
93951996	dibromochloromethane-13C	27	95.6	16.9	88.9	102.3
93952002	trichloroethene-13C2	27	68.7	17.9	61.6	75.8
93952013	benzo(k)fluoranthene-d12	25	98.1	47.6	78.4	117.7
93952024	bis(2-chloroethyl) ether-d8	25	66.6	18.4	59.0	74.2
93952035	p-cymene-d14	25	61.4	18.5	53.8	69.0
93952046	dibenzofuran-d8	25	85.3	14.3	79.4	91.2
93952057	diphenyl ether-d10	25	79.8	15.3	73.5	86.2
93952079	n-C30-d62	25	96.3	80.6	63.0	129.5
93952080	1,2-dichloropropane-d6	27	95.3	8.4	92.0	98.6
93952091	1,1,2-trichloroethane-13C2	27	106.2	13.0	101.0	111.3
93952104	bromodichloromethane-13C	27	95.7	10.8	91.4	100.0
93952115	di-n-butyl phthalate-d4	25	103.6	17.6	96.3	110.8
93952126	diethyl phthalate-d4	25	64.3	22.6	55.0	73.7
93952137	di-n-octyl phthalate-d4	25	100.3	58.4	76.2	124.4
93952148	hexachlorobenzene-13C6	25	87.1	12.8	81.8	92.3
93952159	hexachloroethane-13C	25	56.9	18.6	49.2	64.6
93952160	isophorone-d8	25	72.2	18.5	64.5	79.8

Cmpd#: CAS compound number.
Cmpd Name: Compound name.
Site: Site type.
Location: Sampling location within site.
Phase: Sample phase analyzed (solid/liquid).
Extract: Extraction process (direct/TCLP).
Mean Recovery (%): Mean compound recovery, in percent. (Calculated for stable isotopically-labeled organic compounds based on recoveries from unspiked and spiked field samples, and for all other compounds based on recoveries from spiked field samples.)

Std. of Recovery (%): Standard deviation of the percent recoveries.
Lower 95% C.I.: Lower 95% confidence bound on the mean recovery. (The mean recovery for labeled compounds cannot be negative, so lower confidence limits were taken to be non-negative.)
Upper 95% C.I.: Upper 95% confidence bound on the mean recovery.

construct a complete data frame to include them. As a result, the recoveries are biased somewhat higher and the standard deviations may be biased somewhat lower than if the not detects had been included. EPA will regenerate the statement when the data are available and include it in the record for the Report to Congress.

Statements of Data Quality for Laboratories

Statements of data quality for the determination of the analytes in a reference water matrix were also generated. These are reported in Table 17 as "Statements of Data Quality (Data Quality Indicators) for Laboratories." "Not detects" have not been included in these data because of the time needed to construct a data frame to include them. As a result, the recoveries may be biased somewhat higher and the standard deviations may be biased somewhat lower than if the not detects had been included. EPA will regenerate these statements when the data are available and include them in the record for the Report to Congress.

Frequency of Occurrence of Pollutants

Frequency of occurrence was measured by determining the number of times a given analyte was detected relative to the number of times it was tested for, regardless of concentration. Pollutants occurring frequently are more likely to be indigenous to this industry than those occurring seldom. However, any frequency information, including the data presented in this

Table 17
Statement of Data Quality (Data Quality Indicators) for Laboratories

-- Phase =Liquid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
50328	Benzo(a)pyrene	51	123.5	18.9	118.2	128.8
51285	2,4-Dinitrophenol	47	120.1	15.4	115.6	124.6
53703	Dibenzo(a,h)anthracene	51	146.2	61.5	128.9	163.4
56235	Tetrachloromethane	50	103.4	14.1	99.4	107.4
56553	Benzo(a)anthracene	51	123.1	19.4	117.7	128.6
59507	4-Chloro-3-methylphenol	51	122.1	16.4	117.5	126.8
60297	Diethyl ether	50	100.4	17.2	95.5	105.2
62759	N-Nitrosodimethylamine	51	95.4	20.2	89.8	101.1
67641	2-Propanone	50	101.1	40.2	89.7	112.5
67663	Chloroform	50	101.5	7.4	99.4	103.6
67721	Hexachloroethane	51	156.6	68.2	137.4	175.7
71432	Benzene	50	101.4	7.3	99.3	103.5
71556	1,1,1-Trichloroethane	50	98.4	5.0	97.0	99.9
74839	Bromomethane	50	100.5	5.5	98.9	102.0
74873	Chloromethane	50	102.9	8.3	100.5	105.3
74975	bromochloromethane	50	100.0	0.0	100.0	100.0
75003	Chloroethane	50	102.1	7.6	99.9	104.3
75014	Vinyl chloride	50	98.6	9.7	95.9	101.4
75092	Methylene chloride	50	103.2	24.5	96.3	110.2
75252	Tribromomethane	50	101.7	19.7	96.1	107.3
75274	Bromodichloromethane	50	106.3	6.7	104.4	108.2
75343	1,1-Dichloroethane	50	100.8	5.9	99.1	102.5
75354	1,1-Dichloroethene	50	101.2	9.6	98.5	103.9
77474	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachl	26	39.6	21.4	31.0	48.3
78591	Isophorone	51	123.7	17.4	118.8	128.6
78875	1,2-Dichloropropane	50	98.8	6.5	97.0	100.7
78933	2-Butanone	50	80.6	19.7	75.0	86.2
79005	1,1,2-Trichloroethane	50	98.3	5.0	96.9	99.8
79016	Trichloroethene	50	106.1	10.8	103.0	109.2
79345	1,1,2,2-Tetrachloroethane	50	99.2	10.4	96.3	102.2
83329	Acenaphthene	51	124.5	17.8	119.5	129.5
84662	Diethyl phthalate	51	127.6	38.4	116.8	138.4
84742	Di-n-butyl phthalate	51	123.4	19.6	117.9	128.9
85018	Phenanthrene	51	132.1	21.0	126.2	138.0
85687	Butyl benzyl phthalate	51	136.5	34.4	126.8	146.2
86306	N-Nitrosodiphenylamine	51	119.1	16.4	114.4	123.7
86737	Fluorene	51	117.2	14.0	113.2	121.1
86748	Carbazole	51	139.6	32.6	130.4	148.7
87616	1,2,3-Trichlorobenzene	51	102.0	32.7	92.8	111.2
87683	Hexachlorobutadiene	51	132.8	31.5	123.9	141.6
87865	Pentachlorophenol	49	124.3	19.4	118.7	129.9
88062	2,4,6-Trichlorophenol	51	125.7	22.3	119.4	131.9
88755	2-Nitrophenol	51	124.9	27.2	117.2	132.6
91203	Naphthalene	51	118.1	19.9	112.5	123.7
91587	2-Chloronaphthalene	51	122.7	20.4	117.0	128.4
91598	beta-Naphthylamine	51	205.2	96.6	178.1	232.4
91941	3,3'-Dichlorobenzidine	50	101.7	13.1	98.0	105.5
92524	Biphenyl	51	130.0	24.4	123.1	136.8
92875	Benzidine	50	114.6	23.7	107.8	121.3
95501	1,2-Dichlorobenzene	51	122.6	21.4	116.6	128.6
95578	2-Chlorophenol	51	117.3	16.0	112.8	121.8

Table 17 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Laboratories

--- Phase =Liquid , Extract =Direct ---

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
95954	2,4,5-Trichlorophenol	49	111.8	27.7	103.8	119.7
98555	alpha-Terpineol	51	111.7	28.4	103.7	119.7
98953	Nitrobenzene	51	130.8	19.4	125.4	136.3
99876	p-Cymene	51	118.1	21.6	112.0	124.1
EED164	2,2'-difluorobiphenyl	51	100.0	0.0	100.0	100.0
EGD184	37C1-tetrachlorodibenzo-p-dioxins	3	105.6	2.9	98.4	112.9
EGD191	13C12-pentachlorodibenzo-p-dioxins	3	79.7	7.7	60.5	98.9
EGD192	13C12-hexachlorodibenzo-p-dioxins	3	72.3	12.7	40.6	103.9
EGD193	13C12-tetrachlorodibenzofurans	3	110.9	10.6	84.6	137.1
EGD194	13C12-hexachlorodibenzofurans	3	96.5	15.0	59.2	133.8
EGD429	13C12-2378-tetrachlorodibenzo-p-dioxin	3	81.6	3.2	73.7	89.4
100027	4-Nitrophenol	49	112.5	28.1	104.4	120.6
100414	Ethylbenzene	50	100.9	7.1	98.9	102.9
100425	Styrene	51	143.7	31.1	134.9	152.4
101553	4-Bromophenyl phenyl ether	51	124.1	30.6	115.5	132.7
101848	Diphenyl ether	51	119.5	16.7	114.8	124.2
105679	2,4-Dimethylphenol	51	121.5	19.8	115.9	127.1
106467	1,4-Dichlorobenzene	51	142.0	31.0	133.3	150.8
107028	2-Propenal	50	83.9	44.6	71.2	96.6
107062	1,2-Dichloroethane	50	101.3	7.3	99.3	103.4
107131	Acrylonitrile	50	93.1	26.1	85.7	100.5
108601	bis(2-Chloroisopropyl) ether (Chlorines	51	125.6	11.2	122.5	128.8
108883	Toluene	50	102.3	14.8	98.1	106.5
108907	Chlorobenzene	50	102.9	5.7	101.3	104.5
108952	Phenol	51	119.5	18.4	114.3	124.6
109068	2-Picoline	51	123.4	25.0	116.4	130.4
110565	1,4-dichlorobutane	50	100.0	0.0	100.0	100.0
110758	2-Chloroethylvinyl ether	46	116.5	74.4	94.4	138.6
111444	bis(2-Chloroethyl) ether	51	130.1	27.3	122.4	137.7
111911	bis(2-Chloroethoxy)methane	51	101.7	24.0	94.9	108.4
112403	n-Dodecane	51	154.5	50.2	140.4	168.6
112958	n-Eicosane	51	137.1	25.3	130.0	144.2
117817	bis(2-Ethylhexyl) phthalate	51	130.5	27.3	122.8	138.2
117840	Di-n-octyl phthalate	51	118.9	17.2	114.1	123.7
118741	Hexachlorobenzene	51	115.8	8.6	113.4	118.2
120127	Anthracene	51	121.0	20.6	115.2	126.8
120821	1,2,4-Trichlorobenzene	51	120.7	18.1	115.6	125.8
120832	2,4-Dichlorophenol	51	117.6	13.0	113.9	121.2
121142	2,4-Dinitrotoluene	51	123.9	17.5	118.9	128.8
122394	Diphenylamine	51	113.3	20.0	107.7	119.0
122667	1,2-Diphenylhydrazine	51	136.5	25.8	129.2	143.8
123911	1,4-Dioxane	35	84.9	28.8	75.0	94.8
124185	n-Decane	51	135.0	53.8	119.9	150.1
124481	Dibromochloromethane	50	102.3	4.6	101.0	103.6
127184	Tetrachlorethene	50	109.7	18.2	104.5	114.9
129000	Pyrene	51	124.0	18.6	118.7	129.2
131113	1,2-Benzenedicarboxylic acid, dimethyl e	51	143.8	36.8	133.4	154.1
132649	Dibenzofuran	51	122.0	20.1	116.4	127.7
132650	Dibenzothiophene	51	123.9	21.2	118.0	129.9
156605	trans-1,2-Dichloroethene	50	101.5	17.3	96.6	106.5
191242	Benzo(ghi)perylene	51	122.5	18.5	117.3	127.7

Table 17 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Laboratories

-- Phase =Liquid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
193395	Indeno(1,2,3-cd)pyrene	50	110.6	43.1	98.3	122.8
205992	Benzo(b)fluoranthene	51	106.0	21.7	99.9	112.1
206440	Fluoranthene	51	131.8	22.1	125.6	138.0
207089	Benzo(k)fluoranthene	51	117.1	14.3	113.1	121.1
208968	Acenaphthylene	51	147.7	34.6	138.0	157.4
218019	Chrysene	51	121.3	19.9	115.7	126.9
460004	bromofluorobenzene	41	107.7	26.5	99.3	116.0
534521	Phenol, 2-methyl-4,6-dinitro-	49	123.0	15.7	118.5	127.5
541731	1,3-Dichlorobenzene	51	137.5	34.1	127.9	147.1
544763	n-Hexadecane	51	127.1	18.8	121.8	132.3
593453	n-Octadecane	51	123.4	29.8	115.0	131.8
606202	2,6-Dinitrotoluene	51	120.2	18.6	115.0	125.4
621647	Di-n-propylnitrosamine	51	105.4	25.8	98.1	112.6
629594	n-Tetradecane	51	97.7	27.0	90.1	105.3
629970	n-Docosane	51	145.4	39.4	134.3	156.4
630013	n-Hexacosane	51	146.8	42.8	134.7	158.8
630024	n-Octacosane	51	136.7	47.0	123.5	149.9
638686	n-Triacontane	51	150.7	33.4	141.4	160.1
646311	n-Tetracosane	51	125.6	13.1	121.9	129.3
666524	acetone-d6	28	86.5	19.6	78.9	94.1
933755	2,3,6-Trichlorophenol	49	114.0	27.5	106.1	121.9
1076433	benzene-d6	50	98.6	5.2	97.1	100.0
1111882	bromomethane-d3	50	103.0	30.7	94.3	111.8
1111893	chloromethane-d3	50	130.1	68.9	110.5	149.6
1146652	naphthalene-d8	51	82.6	16.0	78.1	87.1
1486017	biphenyl-d10	51	95.9	14.9	91.7	100.1
1517222	phenanthrene-d10	51	100.0	18.2	94.9	105.1
1665005	methylene chloride-d2	47	68.2	7.2	66.1	70.3
1718521	pyrene-d10	51	106.6	17.2	101.7	111.4
1718532	benzo(a)anthracene-d12	51	106.8	21.6	100.7	112.9
1719035	chrysene-d12	51	113.7	20.8	107.8	119.5
1719068	anthracene-d10	51	108.1	17.9	103.1	113.2
2037265	toluene-d8	50	108.9	15.4	104.5	113.3
2199691	1,2-dichlorobenzene-d4	51	70.5	23.5	63.9	77.1
2199704	1,3-dichlorobenzene-d4	51	60.2	17.3	55.4	65.1
2199726	1,2,4-trichlorobenzene-d3	51	76.5	15.7	72.1	80.9
2679892	diethyl ether-d10	50	92.8	10.7	89.8	95.8
2747582	1,1,1-trichloroethane-d3	50	102.2	15.7	97.7	106.7
3017956	2-bromo,1-chloropropane	50	100.0	0.0	100.0	100.0
3114554	chlorobenzene-d5	50	113.1	17.8	108.1	118.2
3855821	1,4-dichlorobenzene-d4	51	59.4	17.6	54.4	64.3
4165600	nitrobenzene-d5	51	80.4	10.8	77.3	83.4
4165622	phenol-d5	51	73.2	20.2	67.5	78.8
5161295	styrene-d5	51	49.6	14.0	45.7	53.6
6745353	vinyl chloride-d3	50	97.1	35.5	87.0	107.1
7005723	4-Chlorophenylphenyl ether	51	131.5	23.1	125.0	138.0
10061026	Trans-1,3-Dichloropropene	50	97.4	7.7	95.2	99.6
15067202	acenaphthene-d10	51	91.3	16.3	86.7	95.9
15716082	n-C16-d34	51	84.1	11.0	81.0	87.2
16416298	n-C10-d22	51	46.0	15.6	41.6	50.4
16416301	n-C12-d26	51	61.7	13.5	57.9	65.5

Table 17 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Laboratories

-- Phase =Liquid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
16416323	n-C24-d50	51	110.6	26.4	103.2	118.0
17070070	1,2-dichloroethane-d4	50	95.5	18.2	90.3	100.7
19199918	chloroethane-d5	50	83.5	22.3	77.2	89.8
22280735	1,1-dichloroethane-d2	50	92.1	16.1	87.5	96.7
25837052	ethylbenzene-d10	50	111.2	18.6	105.9	116.5
31717449	chloroform-13C	50	92.1	11.8	88.7	95.4
32488496	tetrachlorethene-13C2	50	83.2	16.6	78.5	87.9
32488509	carbon tetrachloride-13C	50	99.2	23.2	92.6	105.7
33262292	dibenzothiophene-d8	51	100.1	17.7	95.1	105.1
33685540	1,1,2,2-tetrachloroethane-d2	50	95.7	11.4	92.5	98.9
33984053	acrolein-d4	25	75.8	36.4	60.8	90.8
37055519	diphenylamine-d10	51	88.1	12.6	84.6	91.7
42366472	trans-1,2-dichlorethene-d3	50	94.1	16.1	89.5	98.7
53389267	methyl ethyl ketone-d3	2	16.3	3.7	0.0	49.6
53807264	acrylonitrile-d3	49	90.2	19.9	84.5	96.0
56912777	1,1-dichloroethane-d3	50	91.2	14.1	87.2	95.2
62369679	n-C20-d42	51	98.9	14.4	94.8	102.9
63466717	benzo(a)pyrene-d12	51	109.6	33.4	100.2	119.0
72802814	bromoform-13C	47	102.1	40.7	90.1	114.1
81103799	fluorene-d10	51	99.3	17.5	94.4	104.2
85380741	pentachlorophenol-13C6	49	77.6	26.7	69.9	85.2
92890636	benzidine-d8	50	63.8	31.9	54.7	72.8
93951667	benzo(ghi)perylene-d12	51	107.2	43.5	94.9	119.4
93951678	bis(2-chloroisopropyl) ether-d12	51	82.8	17.6	77.9	87.8
93951689	2,4-dinitrotoluene-d3	51	98.0	18.9	92.7	103.3
93951690	fluoranthene-d10	51	103.5	16.5	98.9	108.2
93951703	hexachlorobutadiene-13C4	51	73.9	18.7	68.7	79.2
93951714	hexachlorocyclopentadiene-13C4	18	39.4	14.0	32.4	46.3
93951725	4-chloro-3-methylphenol-d2	51	84.5	17.5	79.5	89.4
93951736	2-chlorophenol-d4	51	73.5	14.6	69.4	77.6
93951747	2,4-dichlorophenol-d3	51	82.0	24.4	75.1	88.9
93951751	2-nitrophenol-d4	49	84.3	16.4	79.6	89.0
93951758	2,4-dimethylphenol-d3	51	51.1	10.8	48.1	54.1
93951769	2-methyl-4,6-dinitrophenol-d2	49	87.1	22.4	80.7	93.6
93951770	2,4-dinitrophenol-d3	47	62.7	33.4	52.9	72.5
93951792	4-nitrophenol-d4	51	78.8	32.5	69.6	87.9
93951805	2,4,6-trichlorophenol-d2	49	91.3	16.7	86.5	96.1
93951849	2-chloronaphthalene-d7	51	87.5	14.0	83.6	91.4
93951850	4-chlorophenyl phenyl ether-d5	51	87.7	12.2	84.3	91.2
93951861	trans-1,3-dichloropropene-d4	50	87.2	8.1	84.9	89.5
93951872	bis(2-ethylhexyl) phthalate-d4	51	108.8	21.4	102.8	114.9
93951894	dimethyl phthalate-d4	51	48.7	17.4	43.8	53.6
93951907	2,6-dinitrotoluene-d3	51	94.4	15.0	90.2	98.6
93951918	3,3'-dichlorcbenzidine-d6	51	104.5	21.2	98.6	110.5
93951929	1,2-diphenylhydrazine-d10	51	88.1	12.5	84.6	91.6
93951930	alpha-picoline-d7	51	67.6	13.9	63.7	71.5
93951941	beta-naphthylamine-d7	51	75.7	31.6	66.8	84.6
93951952	N-nitrosodiphenylamine-d6	51	92.6	12.7	89.0	96.1
93951974	acenaphthylene-d8	51	76.4	8.7	74.0	78.8
93951985	benzo(b)fluoranthene-d12	51	119.4	46.2	106.4	132.4
93951996	dibromochloromethane-13C	50	102.7	11.3	99.4	105.9

Table 17 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Laboratories

-- Phase =Liquid , Extract =Direct --

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
93952002	trichloroethene-13C2	50	83.2	8.7	80.7	85.7
93952013	benzo(k)fluoranthene-d12	51	113.2	42.9	101.1	125.2
93952024	bis(2-chloroethyl) ether-d8	51	77.2	12.1	73.8	80.6
93952035	p-cymene-d14	51	68.9	18.9	63.6	74.2
93952046	dibenzofuran-d8	51	93.9	15.1	89.7	98.2
93952057	diphenyl ether-d10	51	89.7	16.9	85.0	94.5
93952068	alpha-terpineol-d3	22	66.1	18.5	57.9	74.3
93952079	n-C30-d62	51	96.6	22.6	90.3	103.0
93952080	1,2-dichloropropane-d6	50	97.7	4.3	96.4	98.9
93952091	1,1,2-trichloroethane-13C2	50	101.7	8.8	99.2	104.2
93952104	bromodichloromethane-13C	50	97.5	7.8	95.3	99.7
93952115	di-n-butyl phthalate-d4	51	96.7	21.4	90.6	102.7
93952126	diethyl phthalate-d4	51	66.9	22.2	60.7	73.2
93952137	di-n-octyl phthalate-d4	51	118.4	27.9	110.6	126.3
93952148	hexachlorobenzene-13C6	51	98.2	15.4	93.8	102.5
93952159	hexachloroethane-13C	51	52.6	20.6	46.8	58.4
93952160	isophorone-d8	51	80.3	11.7	77.0	83.5
1-001	Total volatile organic carbon	2	106.0	0.0	106.0	106.0
1-002	Biochemical Oxygen Demand	47	100.2	15.5	95.7	104.8
1-003	Chloride	64	102.0	5.7	100.6	103.4
1-004	Chemical Oxygen Demand	37	93.9	7.7	91.4	96.5
1-005	Nitrate/nitrite	32	99.7	4.0	98.3	101.1
1-006	Hydrogen ion	73	100.4	1.0	100.2	100.6
1-007	Oil and grease	6	94.3	6.3	87.7	101.0
1-009	Residue, non-filterable	34	98.0	2.6	97.1	98.9
1-010	Residue, filterable	36	100.6	7.3	98.1	103.1
1-011	Specific conductivity	31	99.6	1.4	99.1	100.2
1-012	Total organic carbon	58	103.8	9.1	101.4	106.2
57125	Cyanides (soluble salts and complexes) N	86	96.2	6.1	94.9	97.5
7429905	Aluminum	61	97.8	6.2	96.2	99.4
7439896	Iron	78	100.1	5.2	98.9	101.3
7439921	Lead	44	104.6	9.2	101.8	107.4
7439954	Magnesium	67	99.1	5.7	97.7	100.5
7439965	Manganese	48	100.5	4.2	99.2	101.7
7439976	Mercury	40	101.0	10.9	97.5	104.5
7439987	Molybdenum	28	98.9	5.7	96.7	101.1
7440020	Nickel	48	98.8	4.3	97.5	100.1
7440097	Potassium	48	96.4	4.1	95.2	97.6
7440224	Silver	73	100.0	7.5	98.3	101.7
7440235	Sodium	58	98.3	4.4	97.1	99.4
7440280	Thallium	64	99.6	9.0	97.3	101.8
7440315	Tin	30	95.8	9.2	92.4	99.3
7440326	Titanium	29	99.0	3.6	97.6	100.3
7440360	Antimony	65	97.6	9.5	95.3	100.0
7440382	Arsenic	64	98.9	9.7	96.5	101.3
7440393	Barium	53	100.8	5.2	99.4	102.3
7440417	Beryllium	41	99.9	4.7	98.4	101.4
7440428	Boron	33	96.6	5.7	94.6	98.6
7440439	Cadmium	48	101.4	3.8	100.2	102.5
7440473	Chromium	48	101.0	6.9	99.0	103.0
7440484	Cobalt	44	101.4	4.5	100.0	102.8

Table 17 (Cont'd)
Statement of Data Quality (Data Quality Indicators) for Laboratories

--------------------------------- Phase =Liquid , Extract =Direct ---------------------------------

Cmpd#	Cmpd Name	N	Mean Recovery (%)	Std. of Recovery (%)	Lower 95% C.I.	Upper 95% C.I.
7440508	Copper	43	98.2	5.3	96.6	99.8
7440622	Vanadium	43	99.5	6.3	97.5	101.4
7440655	Yttrium	25	98.6	3.4	97.2	100.0
7440666	Zinc	53	101.2	4.2	100.0	102.3
7440702	Calcium	78	99.5	5.4	98.3	100.7
7664417	Ammonia	51	92.2	4.8	90.9	93.6
7782492	Selenium	64	99.9	7.0	98.2	101.7
16984488	Fluoride	56	100.6	5.8	99.0	102.1
18496258	Sulfide	33	93.0	4.5	91.4	94.6

Cmpd#: CAS compound number.
Cmpd Name: Compound name.
Site: Site type.
Location: Sampling location within site.
Phase: Sample phase analyzed (solid/liquid).
Extract: Extraction process (direct/TCLP).
Mean Recovery (%): Mean compound recovery, in percent. (Calculated for all compounds based on recoveries from standards spiked into reagent water.)
Std. of Recovery (%): Standard deviation of the percent recoveries.
Lower 95% C.I.: Lower 95% confidence bound on the mean recovery.
Upper 95% C.I.: Upper 95% confidence bound on the mean recovery.

section, must be qualified by noting that the pooling of data to gain a sufficient statistical sample size may mix results that should not be mixed, and conclusions drawn are therefore indicators rather than hard facts.

Frequently Occurring Organic Analytes

Organic analytes that occurred frequently and that were expected in samples collected from this industry (based on data from the Offshore study and from the technical literature) were normal hydrocarbons, aromatic hydrocarbons, and organic acids.

Normal Hydrocarbons

Normal hydrocarbons, C12 through C30 (the carbon range tested) are the predominant organic compounds detected in liquid and solid samples. The most frequently occurring normal hydrocarbon is n-hexadecane, detected in approximately 85 percent of the solid samples and 65 percent of the liquid samples. The most frequently occurring hydrocarbon in TCLP extracts in n-decane, detected in approximately 15 percent of the extracts.

Aromatic Hydrocarbons

Aromatic hydrocarbons, including single ring and polynuclear compounds, were detected in solid samples, liquid samples, and TCLP extracts. Benzene, toluene, and ethyl benzene are present in approximately half of the liquid and solid samples and approximately one-third of the TCLP extracts. Polynuclear aromatics detected ranged from naphthalene and substituted naphthalenes through four ring systems. Biphenyl was the only linked ring hydrocarbon tested for and it was detected. The terpenoid hydrocarbon p-cymene was also detected. Naphthalene occurred with a frequency of approximately 40 percent in solid samples, 60 percent in the liquid samples, and 30 percent in the TCLP extracts. 2-methylnaphthalene occurred in a greater proportion of the TCLP extracts than in the direct analysis of the liquid or solid samples. This higher proportion of occurrence may indicate that this compound may be more readily leached from samples by the TCLP. Alternative explanations may be that a lower detection limit was achieved using the TCLP than for direct analysis of the wastes, because of the interference from other substances in the direct analysis, or that it is formed in the leaching process, although this latter process is unlikely, based on the chemistry involved.

Organic Acids

Phenol; 2,4-dimethylphenol; o-cresol; p-cresol; benzoic acid; and hexanoic were detected at a frequency of approximately 20 to 45 percent (depending on the analyte) in liquid samples, but at a much lower frequency (less than five percent) in solid samples and TCLP extracts.

Other Organic Compounds Detected

Heterocyclic Ring Compounds: dibenzofuran and dibenzothiophene were detected in a few samples.

Ketones: acetone (2-propanone), methyl ethyl ketone (MEK)(2-butanone), methyl isobutyl ketone (MIBK)(4-methyl-2-pentanone), and acetophenone, although acetone is likely attributable to sampling or bottle cleaning contamination.

Phthalates: bis(2-ethylhexyl) phthalate was detected in approximately half of the samples; the other phthalates were detected in approximately five percent of the samples.

Comparison with Results from the "Offshore Oil and Gas Report"

The report entitled "Oil and Gas Extraction Industry, Evaluation of Analytical Data Obtained from the Gulf of Mexico Sampling Program," Volume I, Discussion, Prepared by Burns and Roe Industrial Services Corporation, Paramus, New Jersey, February 4, 1983, is commonly referred to as the "Offshore Oil and Gas Report," and the study it encompassed is commonly referred to as "The 30 Platform Study." The report presents results of a study of produced waters at 30 oil and gas production platforms located in the Gulf of Mexico. The objective of the study was to "characterize the quantities of selected conventional, non-conventional, and priority pollutants present in the produced water discharge from this segment of the industry."

The analytes tested for in the 30 platform study were considerably fewer in number than tested for in this Project. The Offshore list included 88 organics, seven metals, Oil & Grease, Chloride, and Total Dissolved Solids.

Because the 30 Platform Study was specific to produced waters, and this Project included drilling muds, waste pits, centralized treatment systems, and other site categories, the frequency and concentrations cannot be directly compared. However, it is useful to compare the list of analytes detected in the two data sets. These data are summarized in Table 18. Only the analytes detected in the 30 Platform Study are compared.

Table 18. Comparison of Analytes Detected in the "30 Platform Study" and in This Project

CAS #	Name	30 Platform Study	This Project
1-001	Total volatile organic carbon	No test	Detected
1-002	Biochemical Oxygen Demand	No test	Detected
1-003	Chloride	Detected	Detected
1-004	Chemical Oxygen Demand	No test	Detected
1-005	Nitrate/nitrite	No test	Detected
1-006	Hydrogen ion	No test	Detected
1-007	Oil and grease	Detected	Detected
1-008	§esidue, total	No test	Detected
1-009	Residue, non-fiterable	Detected	Detected
1-010	Residue, filterable	No test	Detected
1-011	Specific conductivity	No test	Detected
1-012	Total organic carbon	No test	Detected
1-013	Ignitability	No test	Detected
1-014	Corrosivity	No test	Detected
1-015	Reactivity!"	No test	Detected
1-016	Oil and Grease (retort)	No test	Detected
1-018	Salinity	No test	Detected
1_331	Tetrachlorodibenzo-p-dioxins	No test	Detected
50328	Benzo(a)pyrene	Detected	Not detected
53703	Dibenzo(a,h)anthracene	Detected	Not detected
56325	Tetrachloroethane	Detected	Not detected
56553	Benzo(a)anthracene	Detected	Not detected
57125	Cyanides (soluble salts and co	No test	Detected
58902	2,3,4,6-Tetrachlorophenol	No test	Detected
59507	4-Chloro-3-methylphenol	Detected	Detected
65850	Benzoic acid	No test	Detected
67641	2-Propanone	No test	Detected
67663	Chloroform	Detected	Detected
71432	Benzene	Detected	Detected
71556	1,1,1-Trichloroethane	Not detected	Detected
75092	Methylene chloride	Detected	Detected
75150	Carbon disulfide	No test	Detected
75274	Bromodichloromethane	Not detected	Detected
75343	1,1-Dichloroethane	Detected	Detected
75694	Trichlorofluoromethane	No test	Detected
78591	Isophorone	Not detected	Detected
78933	2-Butanone	No test	Detected
79005	1,1,2-Trichloroethane	Not detected	Detected
79016	Trichloroethene	Not detected	Detected
79345	1,1,2,2-Tetrachloroethane	Not detected	Detected
83329	Acenaphthene	Detected	Detected
84662	Diethyl phthalate	Detected	Detected
84742	Di-n-butyl phthalate	Detected	Detected
85018	Phenanthrene	Detected	Detected
86737	Fluorene	Detected	Detected
87865	Pentachlorophenol	Detected	Detected
91203	Naphthalene	Detected	Detected
91576	2-Methylnaphthalene	No test	Detected

Table 18 (Cont'd). Comparison of Analytes Detected in the "30 Platform Study" and in This Project

CAS #	Name	30 Platform Study	This Project
91941	3,3'-Dichlorobenzidine	Not detected	Detected
92524	Biphenyl	No test	Detected
95487	o-Cresol	No test	Detected
95534	o-Toluidine	No test	Detected
98555	alpha-Terpineol	No test	Detected
98862	Acetophenone	No test	Detected
99876	p-Cymene	No test	Detected
100414	Ethylbenzene	Detected	Detected
100425	Styrene	No test	Detected
100516	Benzyl alcohol	No test	Detected
105679	2,4-Dimethylphenol	Detected	Detected
106445	p-Cresol	No test	Detected
107028	2-Propenal	No test	Detected
107062	1,2-Dichloroethane	Not detected *	Detected
107131	Acrylonitrile	Not detected	Detected
108101	4-Methyl-2-pentanone	No test	Detected
108601	bis(2-Chloroisopropyl) ether	Detected	Not detected
108883	Toluene	Detected	Detected
108907	Chlorobenzene	Detected	Detected
108952	Phenol	Detected	Detected
108985	Benzenethiol	No test	Detected
110758	2-Chloroetylvinyl ether	Not detected	Detected
111444	bis(2-Chloroethyl) ether	Detected	Not detected
112403	n-Dodecane	No test	Detected
112958	n-Eicosane	No test	Detected
117817	bis(2-Ethylhexyl) phthalate	Detected	Detected
117840	Di-n-octyl phthalate	Detected	Detected
120127	Anthracene	Detected	Not detected
121142	2,4-Dinitrotoluene	Not detected	Detected
123911	1,4-Dioxane	No test	Detected
124185	n-Decane	No test	Detected
127184	Tetrachloroethene	Not detected	Detected
129000	Pyrene	Not detected	Detected
131113	Dimethyl phthalate	Detected	Not detected
132649	Dibenzofuran	No test	Detected
132650	Dibenzothiophene	No test	Detected
142621	Hexanoic acid	No test	Detected
205992	Benzo(b)fluoranthene	Detected	Not detected
207889	Benzo(k)fluoranthene	Detected	Not detected
218019	Chrysene	Detected	Detected
544763	n-Hexadecane	No test	Detected
591786	2-Hexanone	No test	Detected
593453	n-Octadecane	No test	Detected
615225	2-(methylthio)benzothiazole	No test	Detected
629594	n-Tetradecane	No test	Detected
629970	n-Docosane	No test	Detected
630013	n-Hexacosane	No test	Detected
630024	n-Octacosane	No test	Detected

Table 18 (Cont'd). Comparison of Analytes Detected in the "30 Platform Study" and in This Project

CAS #	Name	30 Platform Study	This Project
638686	n-Triacontane	No test	Detected
646311	n-Tetracosane	No test	Detected
832699	1-Methylphenanthrene	No test	Detected
1576676	3,6-Dimethylphenanthrene	No test	Detected
1730376	1-Methylfluorene	No test	Detected
1746016	2,3,7,8-Tetrachloro-dibenzo-p-	No test	Detected
7429905	Aluminum	No test	Detected
7439896	Iron	Detected	Detected
7439910	Lanthanum	No test	Detected
7439921	Lead	Detected	Detected
7439932	Lithium	No test	Detected
7439954	Magnesium	No test	Detected
7439965	Manganese	No test	Detected
7439976	Mercury	No test	Detected
7439987	Molybdenum	No test	Detected
7440020	Nickel	Detected	Detected
7440097	Potassium	No test	Detected
7440213	Silicon	No test	Detected
7440224	Silver	Not detected	Detected
7440235	Sodium	No test	Detected
7440246	Strontium	No test	Detected
7440280	Thallium	No test	Detected
7440291	Thorium	No test	Detected
7440315	Tin	No test	Detected
7440326	Titanium	No test	Detected
7440337	Tungsten	No test	Detected
7440360	Antimony	No test	Detected
7440382	Arsenic	No test	Detected
7440393	Barium	No test	Detected
7440417	Beryllium	No test	Detected
7440428	Boron	No test	Detected
7440439	Cadmium	Detected	Detected
7440451	Cerium	No test	Detected
7440473	Chromium	Not detected	Detected
7440484	Cobalt	No test	Detected
7440508	Copper	Detected	Detected
7440622	Vanadium	No test	Detected
7440655	Yttrium	No test	Detected
7440666	Zinc	Detected	Detected
7440699	Bismuth	No test	Detected
7440702	Calcium	No test	Detected
7553562	Iodine	No test	Detected
7664417	Ammonia	No test	Detected
7704349	Sulfur	No test	Detected
7723140	Phosphorus	No test	Detected
7782492	Selenium	No test	Detected
16984488	Fluoride	No test	Detected
18496258	Sulfide	No test	Detected

GLOSSARY AND ABBREVIATIONS

API - American Petroleum Institute.

Barrel (BBL) - Forty-two United States gallons at 60°F.

BOD_5 = Five Day Biochemical Oxygen Demand Test.

BPT - Best Practicable Technology.

BS&W - Bottom sediment and water carried with the oil. Generally, pipeline regulation limits BS&W to 1 percent of the volume of oil.

CA DOHS - California Department of Health Services.

Casing - Large steel pipe used to "seal off" or shut out" water and prevent caving of loose gravel formations when drilling a well. When the casings are set, drilling continues through and below the casing with a smaller bit. The overall length of this casing is called the string of casing. More than one string inside the other may be used in drilling the same well.

Centralized Combined Mud/Produced Water Disposal Pit - An excavated or above grade earthen impoundment remotely located from the oil or gas operations from which it received produced fluids and drilling fluids. Centralized pits usually receive fluids from many wells, leases, or fields.

Centralized Drilling Waste Disposal Pit - An excavated or above grade earthen impoundment remotely located from the drilling operations it receives drilling muds from. Centralized pits usually receive fluids from many drilling sites.

Centralized Produced Water Disposal Pit - An excavated or above grade earthen impoundment remotely located from the oil or gas operations from which it receives produced fluids. Centralized pits usually receive fluids from many wells, leases, or fields.

Centralized Treatment Facilities (Mud or Produced Water) - Any facility accepting drilling fluids or produced fluids for processing. This definition encompasses municipal treatment plants, private treatment facilities, or publicly-owned treatment works for treatment of drilling fluids or produced fluids. These facilities usually accept a spectrum of wastes from a number of oil, gas, or geothermal sites, or in combination with wastes from other sources.

CFR - Code of Federal Regulations.

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Christmas Tree - Assembly of fittings and valves at the tip of the casing of an oil well that controls the flow of oil from the well.

Clean Water Act (CWA) - The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. 1251 et sec.), as amended by the Clean Water Act of 1977 (Pub. L. 95-217).

Closed-In - A well capable of producing oil or gas, but temporarily not producing.

CLP - Contract Laboratory Program (Superfund).

COD - Chemical Oxygen Demand.

Completion Operations - Work performed in an oil or gas well after the well has been drilled to the point where the production string of casing is to be set, including setting the casing, perforating, artificial stimulation, production testing and equipping the well for production, all prior to the commencement of the actual production of oil or gas in paying quantities, or in the case of an injection or service well, prior to when the well is plugged and abandoned.

Condensate - Hydrocarbons which are in the gaseous state under reservoir conditions but which become liquid either in passage up the hole or at the surface.

Connate Water - Water that probably was laid down and entrapped with sedimentary deposits as distinguished from migratory waters that have flowed into deposits after they were laid down.

Cuttings - Small pieces of formation that are the result of the chipping and/or crushing action of the bit.

Cyclone - Equipment, usually cyclone type, for removing drilled sand from the drilling mud stream and from produced fluids.

Desilter - Equipment, normally cyclone type, for removing extremely fine drilled solids from the drilling mud stream.

Development Facility - Any fixed or mobile structure addressed by this document that is engaged in the drilling and completion of productive wells.

Disposal Well - A well through which water (usually salt water) is returned to subsurface formations.

DQO - Data Quality Objective.

Drill Cuttings - Particles generated by drilling into subsurface geologic formations and carried to the surface with the drilling fluid.

Drill Pipe - Special pipe designed to withstand the torsion and tension loads encountered in drilling.

Drilling Fluids - Drilling fluids are circulated down the drill pipe and back up the hole between the drill pipe and the walls of the hole, usually to a surface pit. Drilling fluids are used to lubricate the drill bit, to lift cuttings, to seal off porous zones, and to prevent blowouts. There are two basic drilling media: muds (liquid) and gases. Each medium is comprised of a number of general types. The type of drilling fluid may be further broken down into numerous specific formulations.

Drilling Mud (Reserve) Pit - An excavated or above grade earthen impoundment on a well site that holds drilling mud, connate water, stimulation fluids, completion fluids, or other wastes produced by or associated with drilling.

Dry Hole - A non-producing well.

EMSL-LV - Environmental Monitoring System Laboratory, Las Vegas.

Enhanced Oil Recovery (ref. 1, definition not copied in entirety)- The increased recovery from a pool achieved by artificial means or by the application of energy extrinsic to the pool, which artificial means or application includes pressuring, cycling, pressure maintenance or injection to the pool of a substance or form of energy but does not include the injection in a well of a substance or form of energy for the sole purpose of (1) aiding in the lifting of fluids in the well, or (2) stimulating the reservoir at or near the well by mechanical, chemical, thermal, or explosive means.

EPA - United States Environmental Protection Agency.

Exploration Facility - Any fixed or mobile structure addressed by this document that is engaged in the drilling of wells to determine the nature of potential hydrocarbon reservoirs.

Field - The area around a group of producing wells.

Flocculation - The combination or aggregation of suspended solid particles in such a way that they form small clumps or tufts resembling wool.

Flowing Well - A well which produces oil or gas without any means of artificial lift.

Formation - Various subsurface geological strata penetrated by well bore.

Free Water Knockout - An oil/water separation tank at atmospheric pressure.

Gas-Oil Ratio - Number of cubic feet of gas produced with a barrel of oil.

Gathering Line - A pipeline, usually of small diameter, used in gathering crude oil from the oil field to a point on a main pipeline.

GC - Gas chromatography.

Gun Barrel - An oil-water separation vessel.

IBM - International Business Machines.

ICP - Inductively coupled plasma spectrometry.

Inhibitor - An additive which prevents or retards undesirable changes in the product. Particularly, oxidation and corrosion; and sometimes paraffin formation.

Injection - Introduction of drilling fluids or produced fluids into an underground geologic formation, usually for disposal purposes.

Invert Oil Emulsion Drilling Fluid - A water-in-oil emulsion where fresh or salt water is the dispersed phase and diesel, crude, or some other oil is the continuous phase. Water increases the viscosity and oil reduces the viscosity.

ITD - Industrial Technology Division in the Office of Water Regulations and Standards in the Office of Water.

Location (Drill Site) - Place at which a well is to be or has been drilled.

Location (Sample Point) - Place within a pit or process at which a sample has been taken.

Marginal Well - An oil or gas well which produces such a small volume of hydrocarbons that the gross income therefrom provides only a small margin of profit, or, in many cases, does not even cover the cost of production. ("Marginal well" should be distinguished from the definition for "stripper well" in 44 FR 22073.)

Mud Pit - A steel or earthen tank which is part of the surface drilling mud system.

Mud Pump - A reciprocating, high pressure pump used for circulating drilling mud.

Multiple Completion - A well completion which provides for simultaneous production from separate zones.

NCC - National Computer Center.

NPDES Permit - A National Pollutant Discharge Elimination System permit issued under Section 402 of the Act.

NSPS - New source performance standards.

OSW - Office of Solid Waste.

OWRS - Office of Water Regulations and Standards.

PC - Personal computer.

Priority Pollutants - The 65 pollutants and classes of pollutants declared toxic under Section 307(a) of the Act. Appendix C contains a listing of specific elements and compounds.

Produced Sand - Slurried particles used in hydraulic fracturing and the accumulated formation sands and scale particles generated during production.

Produced Water - The water (brine) brought up from the hydrocarbon-bearing strata during the extraction of oil and gas, and can include formation water, injection water, and any chemicals added downhole or during the oil/water separation process.

Production Facility - Any platform or fixed structure addressed by this document that is used for active recovery of hydrocarbons from producing formations.

Publicly Owned Treatment Works (POTWs) - A treatment facility as defined by section 212 of The Act, which is owned by a state or municipality. (Refer to The Act, below.) An "approved POTW treatment program" or "Program" or "Pretreatment Program" means a program administered by at POTW that meets the requirements established in 40 CFR 403, and which has been approved by a Regional Administrator or State Director in accordance with 40 CFR 403.

QA/QC - Quality Assurance/Quality Control.

RCRA - The Resource Conservation and Recovery Act of 1976, as amended.

SAS - Statistical Analysis System.

SCC - Sample Control Center.

Separation - A process whereby liquid hydrocarbons are separated from gas. The term is sometimes used to describe a relatively simple process distinguished from fractionation.

Stimulation - Any action taken by well operator to increase the inherent productivity of an oil or gas well including, but not limited to, fracturing, shooting or acidizing, but excluding cleaning out, bailing or workover operations.

Stripper Wells - Wells in a field producing an average of less than 10 barrels of oil per calendar day per well. Water injection wells and gas wells are excluded from the calculation of average daily oil production for a field.

Supernatant - A liquid or fluid phase of any earthen pit containing wastes.

Tank Bottom Sludge - Sediment, oil, water, and other substances that tend to concentrate in the bottom of production field vessels, especially stock tanks, are called field tank bottom sludges. This layer of sludge may be periodically removed to prevent oil contamination.

TCLP - Toxicity Characteristic Leaching Procedure.

TSS - Total Suspended Solids.

Workover - To clean out or otherwise work on a well in order to increase or restore production. A typical workover is cleaning out a well that has sanded up. Tubing is pulled, the casing and bottom of the hole washed out with mud, and (in some cases) explosives set off in the hole to dislodge the silt and sand.

Workover Fluids - Any type of fluid used in the workover operation of a well.